B.2.4 LOWER COLUMBIA RIVER STEELHEAD

B.2.4.1 Summary of Previous BRT Conclusions

The status of Lower Columbia River steelhead was initially reviewed by NMFS in 1996 (Busby et al. 1996), and the most recent review occurred in 1998 (NMFS 1998a). In the 1998 review, the BRT noted several concerns for this ESU, including the low abundance relative to historical levels, the universal and often drastic declines observed since the mid-1980s, and the widespread occurrence of hatchery fish in naturally spawning steelhead populations. Analysis also suggested that introduced summer steelhead may negatively affect winter native winter steelhead in some populations. A majority of the 1998 BRT concluded that steelhead in the lower Columbia ESU were at risk of becoming endangered in the foreseeable future.

Current Listing Status: threatened

B.2.4.2 New Data and Update Analyses

New data available for this update included: recent spawner data, additional data on the fraction of hatchery-origin spawners, recent harvest rates, updated hatchery release information, and a compilation of data on resident *O. mykiss*. For many of the Washington chinook salmon populations, the Washington Department of Fish and Wildlife (WDFW) has conducted analyses using the Ecosystem Diagnosis and Treatment (EDT) model (Busack and Rawding 2003). The EDT model attempts to predict fish population performance based on input information about reach-specific habitat attributes (http://www.olympus.net/community/dungenesswc/EDT-primer.pdf). New analyses for this update include the designation of demographically independent populations, recalculation of previous BRT metrics with additional years' data, estimates of median annual growth rate (λ) under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

Results of new analyses

Historical population structure—As part of its effort to develop viability criteria for Lower Columbia River steelhead, The Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) has identified historically demographically independent populations (Myers et al. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany et al. 2000). Myers et al. hypothesized that the ESU historically consisted of 17 winter-run populations and six summer-run populations for a total of 23 populations (Figures B.2.4.1 and B.2.4.2). The populations identified in Myers et al. are used as the units for the new analyses in this report.

The WLC-TRT partitioned Lower Columbia River steelhead populations into a number of "strata" based on major life-history characteristics and ecological zones (McElhany et al. 2003). Analysis by the WLC-TRT suggests that a viable ESU would need multiple viable populations in each of these strata. The strata and associated populations are identified in Table B.2.4.1.

Table B.2.4.1. Historical population structure and abundance statistics for Lower Columbia River steelhead populations. The populations are partitioned into ecological zones and major life-history types. The ecological zones are based on ecological community and hydro dynamic patterns and life-history types are based on traits related to run timing. Time series used for the summary statistics are referenced in Appendix B.5.4.

<table>
<tr><th>Life History</th><th>Ecological Zone</th><th>Population</th><th>Years of Data for Recent Means</th><th>Recent Geometric Mean Total Spawners</th><th>Recent Arithmetic Mean Total Spawners</th><th>Recent Arithmetic Mean Percent Hatchery-origin Spawners</th></tr>
<tr><td rowspan="17">Winter Run</td><td rowspan="14">Cascade</td><td>Cispus River Winter Run</td><td rowspan="3">2002</td><td rowspan="3">2,787</td><td rowspan="3">2,787</td><td rowspan="3">73%</td></tr>
<tr><td>Tilton River Winter Run</td></tr>
<tr><td>Upper Cowlitz River Winter Run</td></tr>
<tr><td>Lower Cowlitz River Winter Run</td><td colspan="4">No Data</td></tr>
<tr><td>Coweeman River Winter Run</td><td>1998-2002</td><td>466</td><td>490</td><td>50%</td></tr>
<tr><td>South Fork Toutle River Winter</td><td>1998-2002</td><td>504</td><td>5034</td><td>2%</td></tr>
<tr><td>North Fork Toutle River Winter</td><td>1998-2002</td><td>196</td><td>207</td><td>0%</td></tr>
<tr><td>Kalama River Winter Run</td><td>1998-2002</td><td>726</td><td>797</td><td>0%</td></tr>
<tr><td>North Fork Lewis Winter Run</td><td colspan="4">No Data</td></tr>
<tr><td>East Fork Lewis Winter Run</td><td colspan="4">Index Data only; no abundance means available</td></tr>
<tr><td>Salmon Creek Winter Run</td><td colspan="4">No Data</td></tr>
<tr><td>Washougal River Winter Run</td><td>1998-2002</td><td>323</td><td>376</td><td>0%</td></tr>
<tr><td>Clackamas River Winter Run</td><td>1997-2001</td><td>560</td><td>717</td><td>41%</td></tr>
<tr><td>Sandy River Winter Run</td><td>1997-2001</td><td>977</td><td>997</td><td>42%</td></tr>
<tr><td rowspan="3">Gorge</td><td>Lower Gorge Tributaries Winter</td><td colspan="4">No Data</td></tr>
<tr><td>Upper Gorge Tributaries Winter</td><td colspan="4">No Data</td></tr>
<tr><td>Hood River Winter Run</td><td>1996-2000</td><td>756</td><td>792</td><td>52%</td></tr>
<tr><td>Summer Run</td><td>Cascade</td><td>Kalama River Summer Run</td><td>1999-2003</td><td>474</td><td>633</td><td>32%</td></tr>
</table>

		North Fork Lewis Summer Run	No Data			
		East Fork Lewis Summer Run	1999-2003	434	514	25%
		Washougal River Summer Run	1999-2003	264	313	8%
	Gorge	Wind River Summer Run	1999-2003	472	535	5%
		Hood River Summer Run	1996-2000	931	1,003	83%

Abundance and trends

References for abundance time series and related data are in Appendix B.5.4. Recent abundance of total spawners, and recent fraction of hatchery-origin spawners for Lower Columbia River steelhead populations are summarized in Table B.2.4.1. The abundance means in Table B.2.4.1 are for total spawners and include both natural and hatchery-origin fish. Natural-origin fish had parents that spawned in the wild as opposed to hatchery-origin fish whose parents were spawned in a hatchery. A number of the populations have a substantial fraction of hatchery-origin spawners in the spawning areas and are hypothesized to be sustained largely by hatchery production. Exceptions are the Kalama, the North Fork Toutle, the South Fork Toutle, and East Fork Lewis winter-run populations, which have few hatchery fish spawning on the natural spawning areas. These populations have relatively low recent mean abundance estimates, with the largest being the Kalama (geometric mean of 726 spawners).

The pooled estimate of abundance for the historical Cispus, Tilton and Upper Cowlitz populations has the highest recent total spawner abundance in the ESU, but also the largest fraction of hatchery-origin spawners. The hatchery-origin spawners are part of a reintroduction program to establish steelhead above Cowlitz Falls dam, the upper most of impassable three dams on the mainstem Cowlitz (Serl and Morrill 2002). Adults are collected below the most downstream dam (Mayfield) and trucked above Cowlitz Falls. Downstream survival of juvenile steelhead though the dams and reservoirs is considered negligible, so juveniles are collected at Cowlitz Falls and trucked downstream. The current collection efficiency of juveniles at Cowlitz Falls is considered too low for the reintroduction to be self-sustaining (Rawding 2003 pers. com.).

Where data are available, the abundance time series information for each of the populations is presented in Figures B.2.4.3.-B.2.4.23. Two types of time series figures are presented. The first type of figure plots abundance over time (Figures B.2.4.3, B.2.4.5, B.2.4.7, B.2.4.9, B.2.4.11, B.2.4.13, B.2.4.15-B.2.4.19, B.2.4.21, and B.2.4.23). Where possible, two lines are presented on the abundance figure, where one line is the total number of spawners (or total count at a dam) and the other line is the number of fish of natural origin. In some cases, data were not available to distinguish between natural and hatchery-origin spawners, so only total spawner (or dam count) information is presented. This type of figure can give a sense of the levels of abundance, overall trend, patterns of variability, and the fraction of hatchery-origin spawners.

The second type of time-series figure presents the total number of spawners (natural and hatchery origin) and the number of preharvest recruits produced by those spawners over broodyear (Figures B.2.4.4, B.2.4. 6, B.2.4.8, B.2.4.10, B.2.4.12, B.2.4.14, B.2.4.20, B.2.4.22, B.2.4.24). Dividing the number of preharvest recruits by the number of spawners for the same time period would yield an estimate of the preharvest recruits per spawner. This type of figure requires harvest and age structure information, and therefore, could be produced for only a limited number of populations. This type of figure can indicate if there have been changes in preharvest recruitment and the degree to which harvest management has the potential to recover populations. If the preharvest recruitment line is consistently below the spawner line, it indicates that the population would not be replacing itself, even in the absence of all harvest.

Summary statistics on population trends and growth rate are presented in Tables B.2.4.2-B.2.4.5 and in Figures B.2.4.25- B.2.4.27. The methods for estimating trends and growth rate (λ) are described in the general methods section. The majority of populations have a long-term trend less than one, indicating the population is in decline. In addition, there is a high probability for most populations that the true trend/growth rate is less than one (Table B.2.4.3). When growth rate is estimated, assuming that hatchery-origin spawners have a reproductive success equal to that of natural-origin spawners, all of the populations have a negative growth rate except the North Fork Toutle winter run, which had very few hatchery-origin spawners (Figure B.2.4.23). The North Fork Toutle population is recovering from the eruption of Mt. St. Helens in 1980 and is still at low abundance (recent mean of 196 spawners). The potential reasons for these declines have been cataloged in previous status reviews and include habitat degradation, deleterious hatchery practices, and climate-driven changes in marine survival.

Rawding (2003) suggests that marine conditions have been a major factor driving the decline observed in the available time series and that marine survival is largely responsible for the increases observed in the last few years. He poses as an important question: What will happen to Lower Columbia River steelhead when the ocean cycles to less productive regimes again? This general issue is discussed in the introduction to the update reports, as it applies to many ESUs.

Table B.2.4.2. Long-term trend and growth rate for a subset of Lower Columbia steelhead populations for which adequate data are available (95% C.I. are in parentheses). The long-term analysis used the entire data set. The trend estimate is for total spawners and includes both natural-origin and hatchery-origin fish. The λ calculation is an estimate of what the natural growth rate would have been after accounting for hatchery-origin spawners. The λ estimate is calculated under two hypotheses about the reproductive success of hatchery-origin spawners. In "Hatchery = 0" columns, hatchery fish are assumed to have zero reproductive success. In the "Hatchery = Wild" columns, hatchery fish are assumed to have the same relative reproductive success as natural-origin fish.

Run	**Population**	**Years for Trend and λ**	**Trend of Total Spawners**	**Median Growth Rate (λ)**	
				Hatchery = 0	**Hatchery = Wild**
Winter	Coweeman	1987-2002	0.916 (0.847-0.990)	0.908 (0.792-1.041)	0.782 (0.678-0.903)

	South Fork Toutle	1984-2002	0.917 (0.876-0.961)	0.938 (0.830-1.059)	0.933 (0.821-1.061)
	North Fork Toutle	1989-2002	1.135 (1.038-1.242)	1.062 (0.915-1.233)	1.062 (0.915-1.233)
	Kalama	1977-2002	0.998 (0.973-1.023)	1.010 (0.913-1.117)	0.916 (0.824-1.019)
	Clackamas	1958-2001	0.979 (0.966-0.993)	0.971 (0.901-1.047)	0.949 (0.877-1.027)
	Sandy	1978-2001	0.940 (0.919-0.960)	0.945 (0.850-1.051)	0.828 (0.741-0.925)
Summer	Kalama	1977-2003	0.928 (0.889-0.969)	0.981 (0.889-1.083)	0.712 (0.642-0.790)
	Washougal	1986-2003	0.991 (0.942-1.043)	1.003 (0.884-1.138)	0.996 (0.872-1.138)
	Wind	1989-2003	0.973 (0.921-1.028)	0.983 (0.853-1.134)	0.937 (0.807-1.089)

Table B.2.4.3. Short-term trend and growth rate for a subset of Lower Columbia steelhead populations for which adequate data are available (95% C.I. are in parentheses). Short-term data sets include data from 1990 to the most recent available year. The trend estimate is for total spawners and includes both natural-origin and hatchery-origin fish. The λ calculation is an estimate of what the natural growth rate would have been after accounting for hatchery-origin spawners. The λ estimate is calculated under two hypotheses about the reproductive success of hatchery-origin spawners. In “Hatchery = 0” columns, hatchery fish are assumed to have zero reproductive success. In the “Hatchery = Wild” columns, hatchery fish are assumed to have the same relative reproductive success as natural-origin fish.

Run	**Population**	**Years for Trend**	**Trend of Total Spawners**	**Median Growth Rate (λ)**	
				Hatchery = 0	**Hatchery = Wild**
Winter	Coweeman	1990-2002	0.941 (0.818-1.083)	0.920 (0.803-1.055)	0.787 (0.682-0.909)
	South Fork Toutle	1990-2002	0.939 (0.856-1.130)	0.933 (0.826-1.054)	0.929 (0.817-1.056)
	North Fork Toutle	1990-2002	1.086 (0.999-1.018)	1.038 (0.894-1.206)	1.038 (0.894-1.206)
	Kalama	1990-2002	1.004 (0.923-1.091)	0.984 (0.890-1.088)	0.922 (0.829-1.025)
	Clackamas	1990-2001	0.914 (0.806-1.036)	0.875 (0.812-0.943)	0.830 (0.767-0.898)
	Sandy	1990-2001	0.889 (0.835-0.946)	0.866 (0.797-0.985)	0.782 (0.700-0.874)
Summer	Kalama	1990-2003	0.855 (0.756-0.968)	0.900 (0.816-0.994)	0.664 (0.598-0.737)
	Washougal	1990-2003	1.024 (0.951-1.104)	1.029 (0.907-1.168)	0.960 (0.841-1.097)
	Wind	1990-2003	0.989 (0.931-1.049)	0.995 (0.863-1.148)	0.903 (0.777-1.049)

Table B.2.4.4. Probability that the long-term abundance trend or growth rate of a subset of Lower Columbia River steelhead populations is less than one. In the “Hatchery = 0” columns, the hatchery-origin fish are assumed to have zero reproductive success. In the “Hatchery = Wild” columns, hatchery-origin fish are assumed to have reproductive success equivalent to that of natural-origin fish.

Run	**Population**	**Years for Trend and λ**	**Prob. Trend <1**	**Prob. λ < 1**	
				Hatchery = 0	**Hatchery = Wild**
Winter	Coweeman	1987-2002	0.985	0.936	1.000
	South Fork Toutle	1984-2002	0.999	0.884	0.899
	North Fork Toutle	1989-2002	0.005	0.063	0.063
	Kalama	1977-2002	0.574	0.405	0.971
	Clackamas	1958-2001	0.998	0.784	0.918
	Sandy	1978-2001	1.000	0.993	1.000
Summer	Kalama	1977-2003	0.999	0.613	1.000
	Washougal	1986-2003	0.644	0.476	0.526
	Wind	1989-2003	0.848	0.639	0.889

Table B.2.4.5. Probability that the long-term abundance trend or growth rate of a subset of Lower Columbia River steelhead populations is less than one. In the “Hatchery = 0” columns, the hatchery-origin fish are assumed to have zero reproductive success. In the “Hatchery = Wild” columns, hatchery-origin fish are assumed to have reproductive success equivalent to that of natural-origin fish.

Run	**Population**	**Years for Trend**	**Prob. Trend <1**	**Prob. λ < 1**	
				Hatchery = 0	**Hatchery = Wild**
Winter	Coweeman	1990-2002	0.822	0.851	0.995
	South Fork Toutle	1990-2002	0.919	0.797	0.812
	North Fork Toutle	1990-2002	0.026	0.135	0.135
	Kalama	1990-2002	0.463	0.593	0.846
	Clackamas	1990-2001	0.929	0.849	0.929
	Sandy	1990-2001	0.999	0.991	1.000
Summer	Kalama	1990-2003	0.991	0.849	1.000
	Washougal	1990-2003	0.249	0.349	0.757
	Wind	1990-2003	0.659	0.538	0.989

EDT-based estimates of historical abundance—The Washington Department of Fish and Wildlife (WDFW) has conducted analyses of the Lower Columbia River chinook populations using the Ecosystem Diagnosis and Treatment (EDT) model (Busack and Rawding 2003). WDFW populated this model with estimates of historical habitat condition, which produced the estimates of average historical abundance shown in Table B.2.4.6. There is a great deal of unquantified uncertainty in the EDT historical abundance estimates, which should be taken into consideration when interpreting these data. In addition, the habitat scenarios evaluated as "historical" may not reflect historical distributions, since some areas that were historically accessible but currently blocked by large dams are omitted from the analyses and some areas that were historically inaccessible but recently passable because of human intervention are included. The EDT outputs are provided here to give a sense of the historical abundance of populations relative to each other and an estimate of the historical abundance relative to the current abundance.

Table B.2.4.6. EDT based estimates of historical abundance for a subset of Lower Columbia River steelhead populations.

Life History	Population	EDT Estimate of Historical Abundance
Winter Run	Coweeman River Winter Run	2,243
	Lower Cowlitz River Winter Run	1,672
	South Fork Toutle River Winter	2,627
	North Fork Toutle River Winter	3,770
	Kalama River Winter Run	554
	North Fork Lewis Winter Run	713
	East Fork Lewis Winter Run	3,131
	Salmon Creek Winter Run	
	Washougal River Winter Run	2,497
	Lower Gorge Tributaries Winter	793
	Upper Gorge Tributaries Winter	243
	Hood River Winter Run	
Summer Run	Kalama River Summer Run	3,165
	East Fork Lewis Summer Run	422
	Washougal River Summer Run	1,419
	Wind River Summer Run	2,288

Loss of habitat from barriers—An analysis was conducted by Steel and Sheer (2003) to assess the number of stream km historically and currently available to salmon populations in the Lower Columbia River (Table B.2.4.7). Stream km usable by salmon are determined based on simple gradient cut offs and on the presence of impassable barriers. Barriers with passage limited to trap-and-haul are considered impassible for this analysis. This approach will over estimate the number of usable stream km as it does not take into consideration habitat quality (other than gradient). However, the analysis does indicate that for some populations, the number of stream habitat km currently accessible is greatly reduced from the historical condition.

Table B.2.4.7. Loss of habitat from barriers. The potential current habitat is the kilometers of stream below all currently impassible barriers between a gradient of 0.5% and 4%. The potential historical habitat is the kilometers of stream below historically impassible barriers between a gradient of 0.5% and 4% (summer) and 0.5% and 6% (winter). The current to historical habitat ratio is the percent of the historical habitat that is currently available.

Population	Potential Current Habitat	Potential Historical Habitat (km)	Current to Historical Habitat Ratio
Cispus River Winter Run	0	87	0%
Coweeman River Winter Run	85	102	84%
Lower Cowlitz River Winter Run	542	674	80%
Upper Cowlitz River Winter Run	6	358	2%
Tilton River Winter Run	0	120	0%
South Fork Toutle River Winter	82	92	8%
North Fork Toutle River Winter	209	330	63%
Kalama River Winter Run	112	122	92%
North Fork Lewis Winter Run	115	525	22%
East Fork Lewis Winter Run	239	315	76%
Salmon Creek Winter Run	222	252	88%
Washougal River Winter Run	122	232	53%
Clackamas River Winter Run	919	1,127	82%
Sandy River Winter Run	295	386	76%
Lower Gorge Tributaries Winter	46	46	99%
Upper Gorge Tributaries Winter	31	31	100%
Hood River Winter Run	138	138	99%
Kalama River Summer Run	49	54	90%
North Fork Lewis Summer Run	78	83	94%
East Fork Lewis Summer Run	87	364	24%
Washougal River Summer Run	181	236	77%
Wind River Summer Run	84	164	51%
Hood River Summer Run	36	41	90%
Total	3,678	5,879	63%

Resident *O. mykiss* considerations

The available information on resident *O. mykiss* populations within the ESU is summarized in Table B.2.1.3 and Appendix B.5.1 and provides a broad overview of the distribution of Case 1, 2, and 3 resident populations within the ESU. See the section on Resident Fish in the Introduction section to the main body of this report for an explanation of the three cases and their relevance to ESU determinations. The section on Resident Fish in section B.1 of this steelhead report discusses how resident fish are considered in risk analyses.

Kostow (2003) has reviewed information on the abundance and distribution of resident *O. mykiss* for this ESU and found no quantitative estimates of abundance for resident *O. mykiss* in any LCR population. However, expert opinion on the distribution and relative abundance of resident *O. mykiss* is available. Expert opinion suggests that resident *O. mykiss* numerically dominate the Wind River Basin, and the West Fork of the Hood basin. However they are considered less common in other portions of the Hood basin. Residents are considered common in the Collowash subbasin of the Clackamas, though rare or possibly absent in other parts of the basin below natural barriers. Resident *O. mykiss* are considered abundant above the Bull Run dams (1929) in the Sandy basin, Merwin Dam (1931) in the Lewis basin and Mayfield Dam (1963) in the Cowlitz basin, but are rare or absent elsewhere in these basins. We are not aware of specific information relevant to the ESU status of Case 3 resident populations above the dams in the Cowlitz, Lewis, or Sandy Rivers. Resident *O. mykiss* are probably common in the upper portions of the Kalama and Washougal basins, but rare in the lower portions. Resident *O. mykiss* are considered absent from all the smaller lower Columbia tributaries that have small patches of spawning anadromous *O. mykiss*. Cutthroat trout, *Oncorhynchus clarki*, tend not to co-occur with resident *O. mykiss* and appear to have historically been the predominant resident trout species in many of the lower Columbia tributaries.

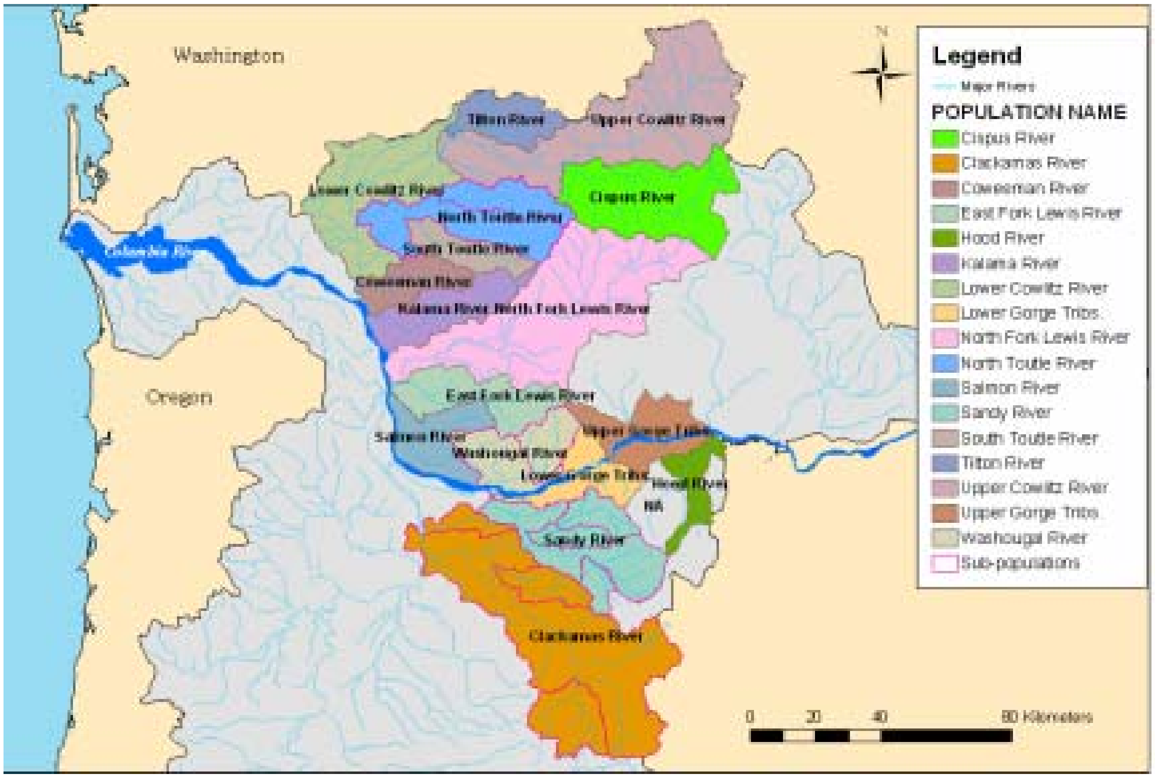


Figure B.2.4.1. Historical populations of winter steelhead in the Lower Columbia ESU (Myers et al. 2002).

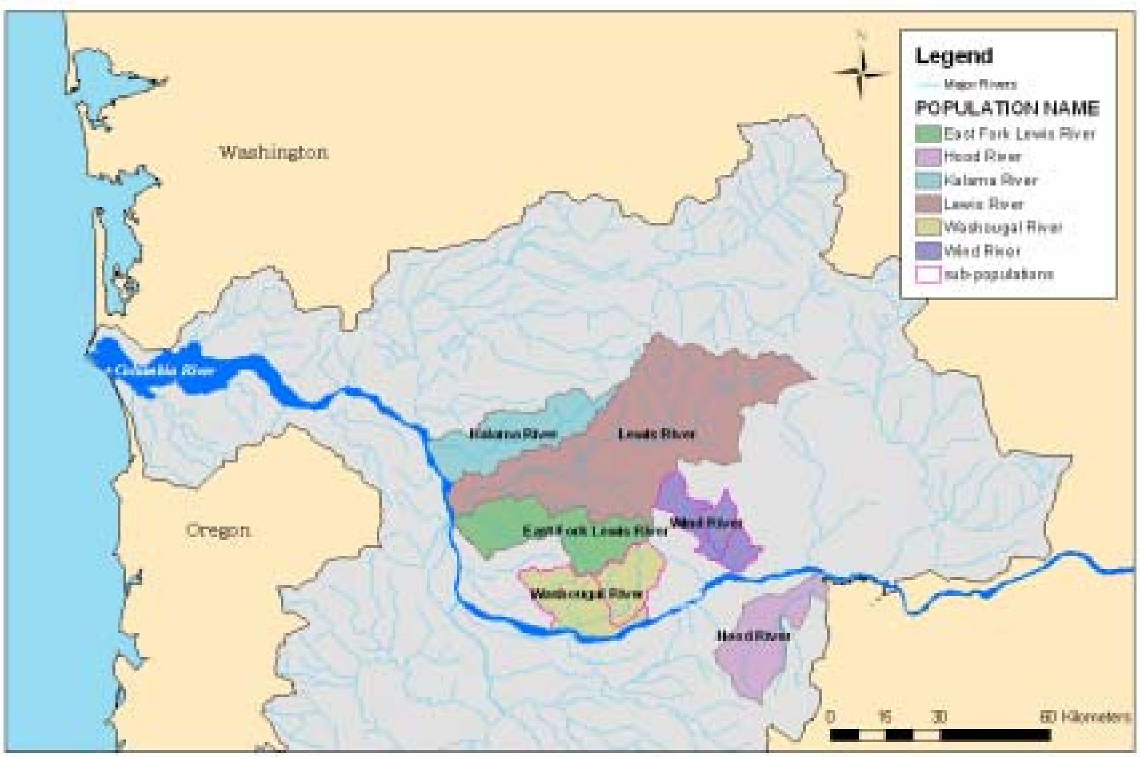


Figure B.2.4.2. Historical populations of summer steelhead in the Lower Columbia ESU (Myers et al. 2002).

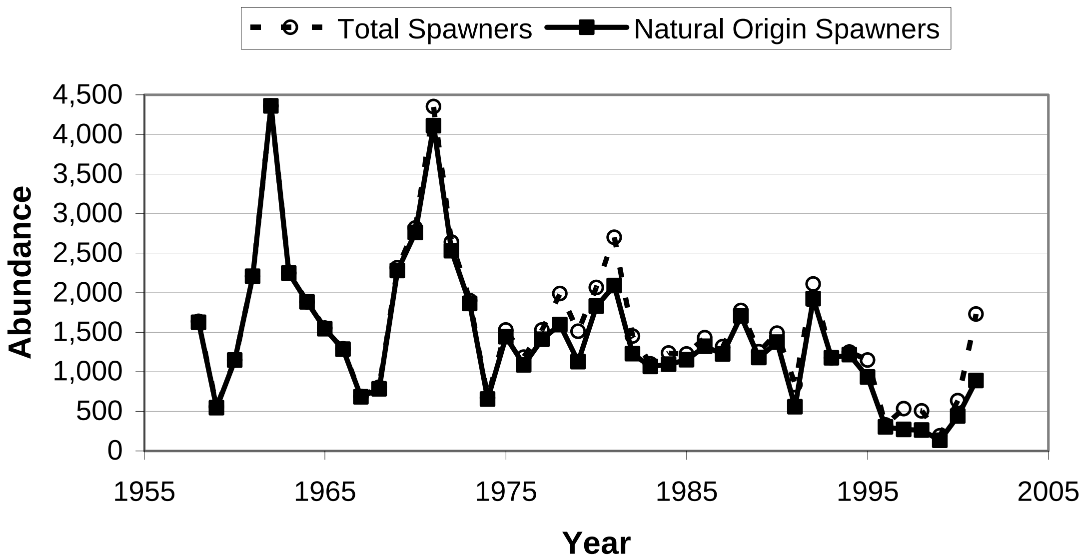


Figure B.2.4.3. Winter steelhead abundance at North Fork dam on Clackamas River (data from Cramer 2002).

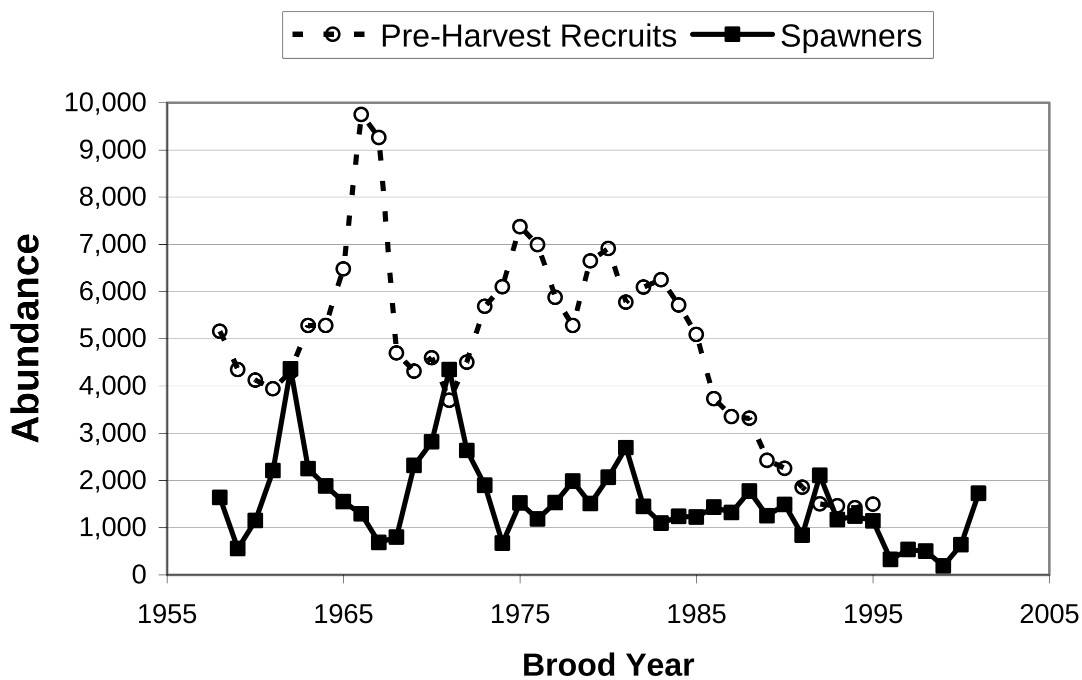
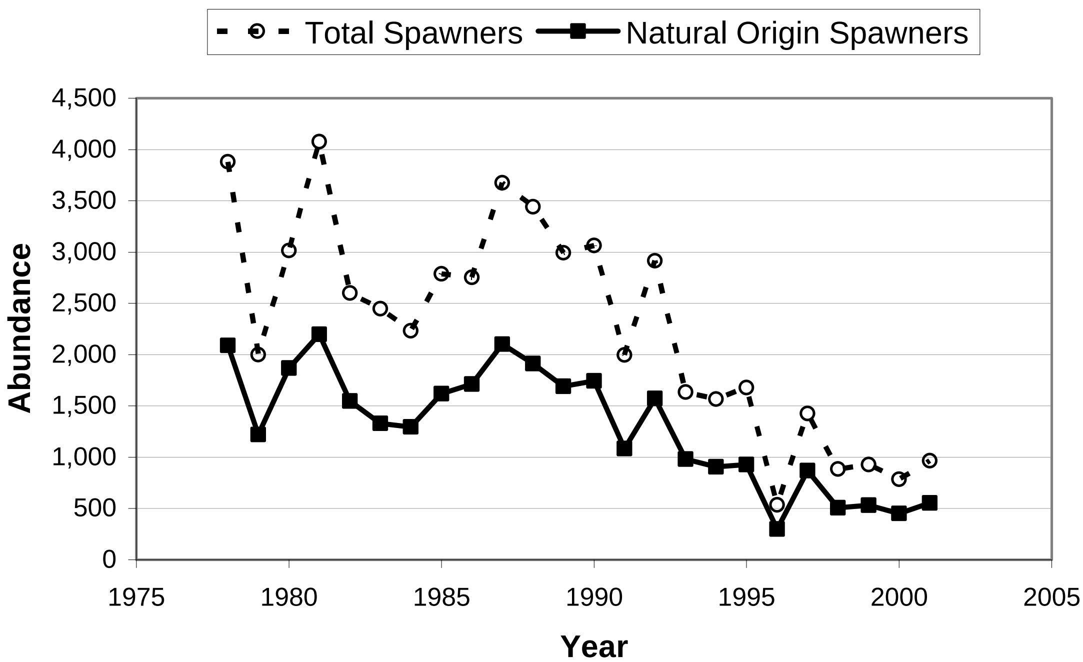
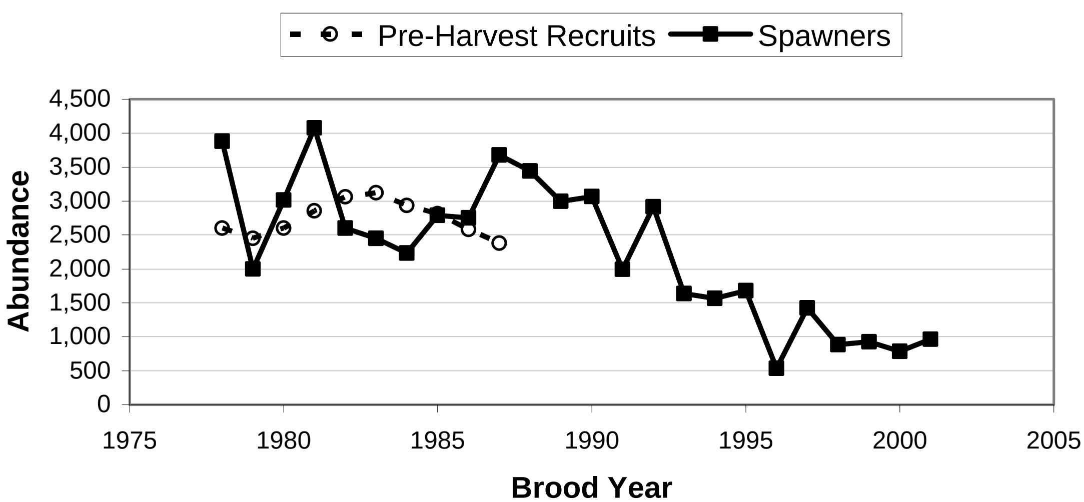


Figure B.2.4.4. Preharvest recruits and spawners for winter steelhead estimated from counts at North Fork Dam on the Clackamas River.



B.2.4.5. Winter steelhead abundance at Marmot dam on the Sandy River (data from Cramer 2002).



B.2.4.6. Preharvest recruits and spawners for winter steelhead estimated from counts at Marmot Dam on the Sandy River.

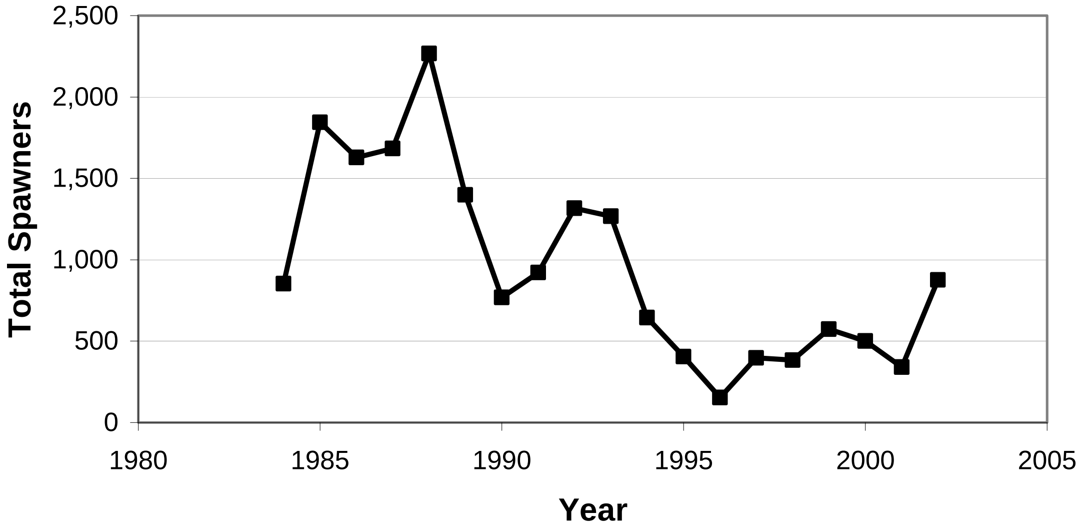


Figure B.2.4.7. Estimate of winter steelhead spawner abundance in the South Fork Toutle River. It is estimated that approximately 2% of the total spawners may be of natural origin.

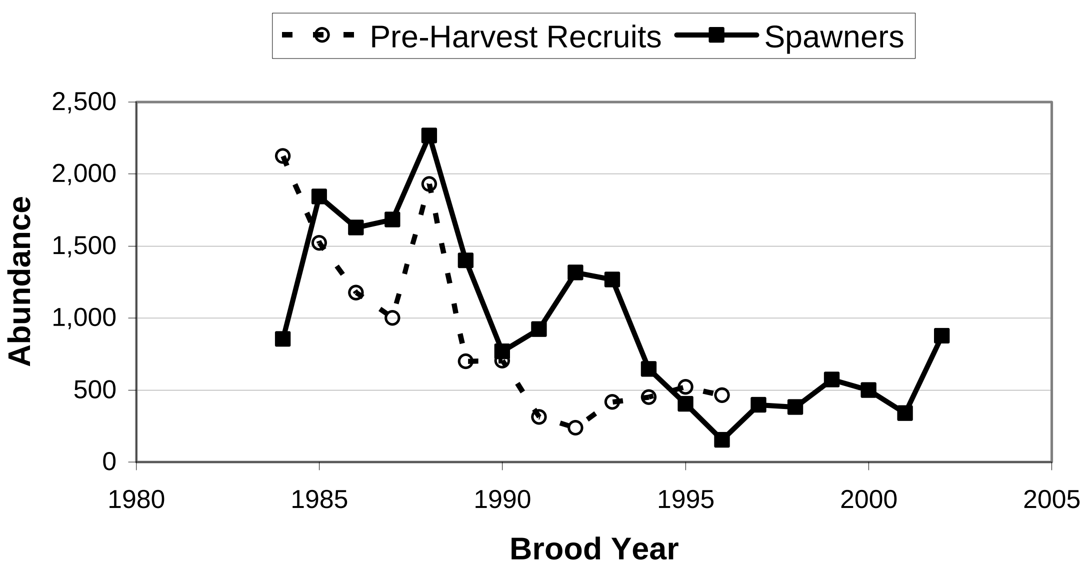


Figure B.2.4.8. Estimate of winter steelhead preharvest recruits and spawners in the South Fork Toutle River.

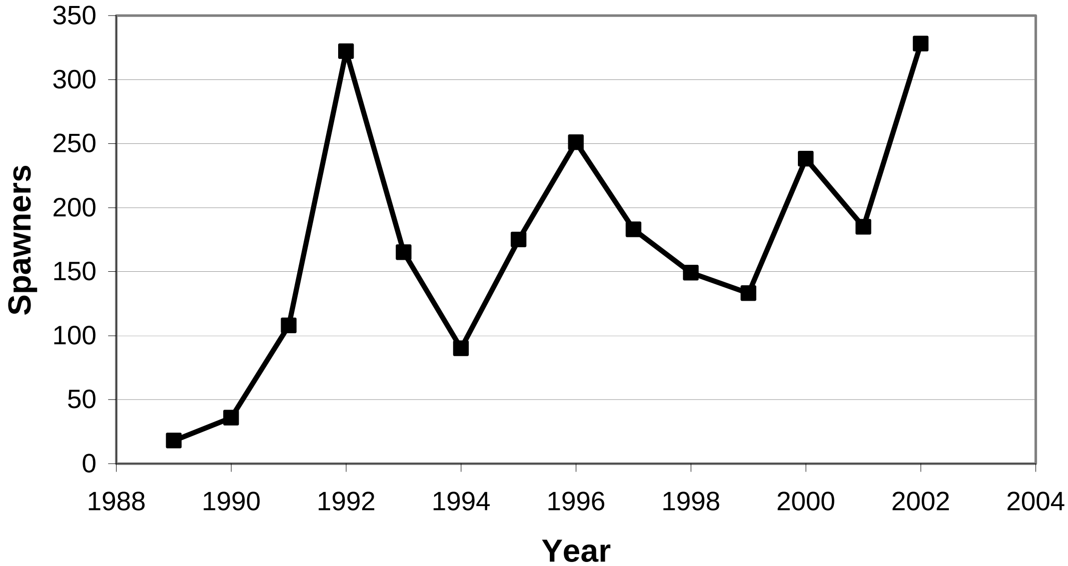


Figure B.2.4.9. Estimate of winter steelhead abundance in the North Fork Toutle. There are estimated to be no hatchery-origin spawners in the North Fork Toutle population.

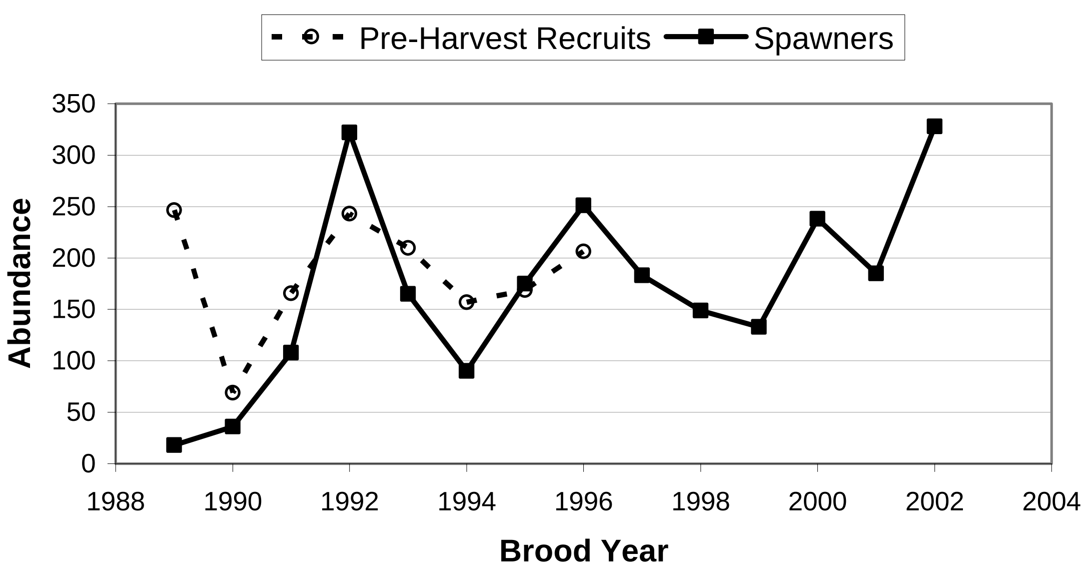
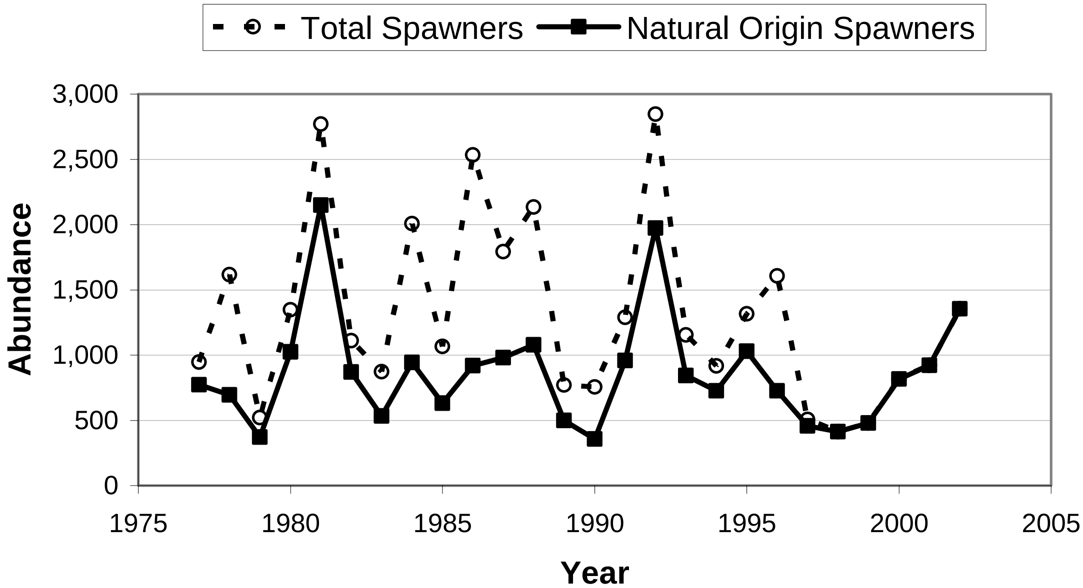


Figure B.2.4.10. Estimate of winter steelhead preharvest recruits and spawners in the North Fork Toutle River.



B.2.4.11. Estimate of winter steelhead abundance in the Kalama River.

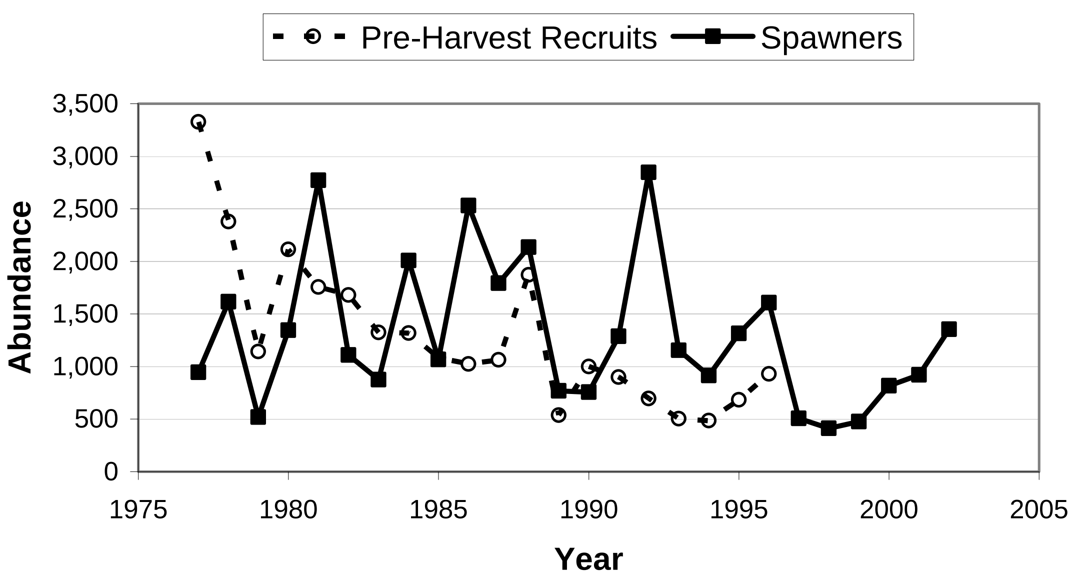
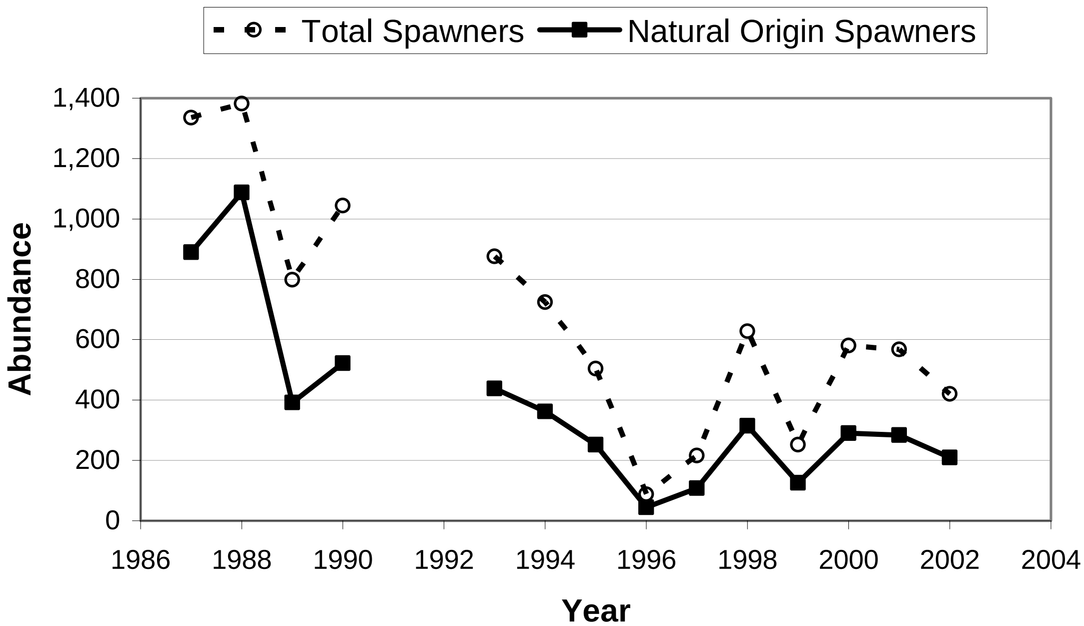


Figure B.2.4.12. Estimate of winter steelhead preharvest recruits and spawners in the Kalama River.



B.2.4.13. Estimate of winter steelhead abundance in the Coweeman River.

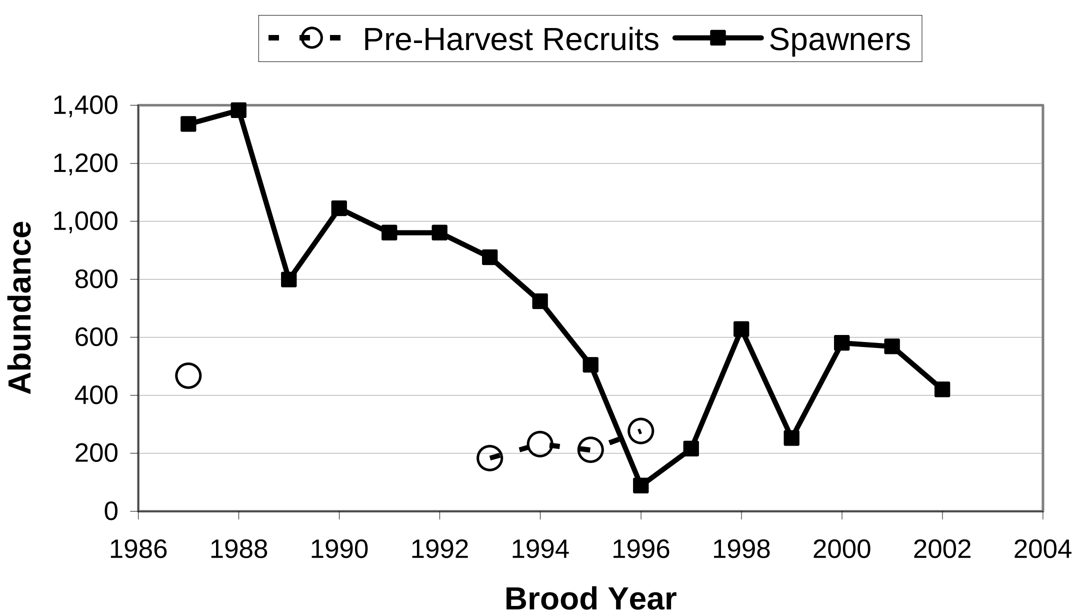


Figure B.2.4.14. Estimate of winter steelhead preharvest recruits and spawners in the Coweeman River.

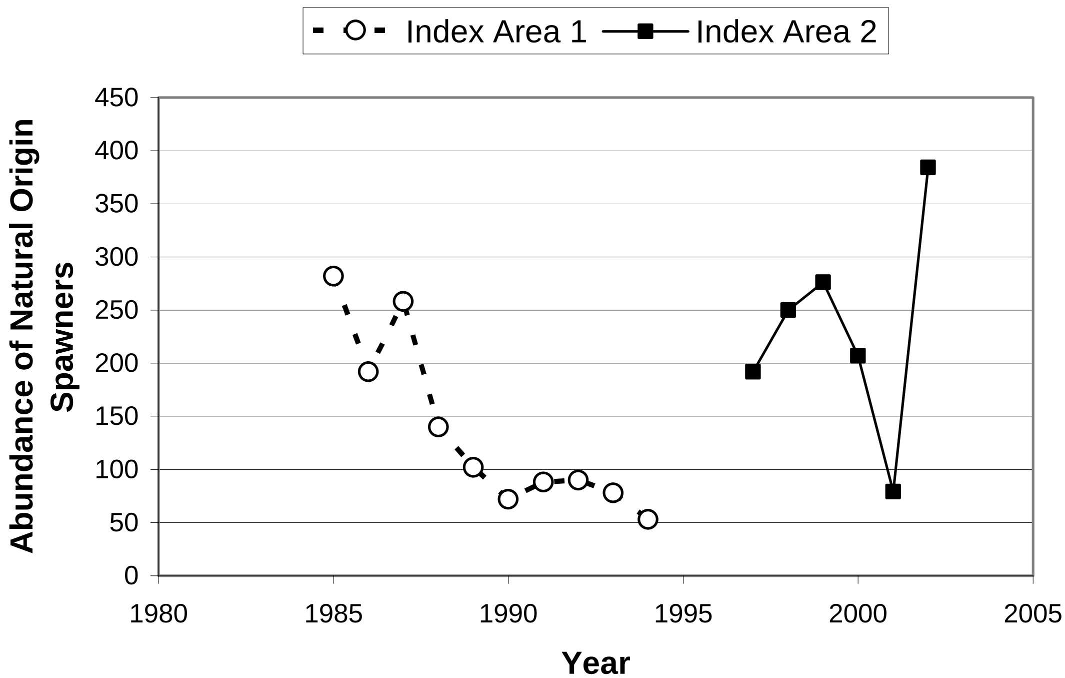


Figure B.2.4.15. Index counts of natural-origin winter steelhead in the East Fork of the Lewis River. The two indexes are for different areas and cannot be directly compared and cannot be used to create a more continuous time trend.

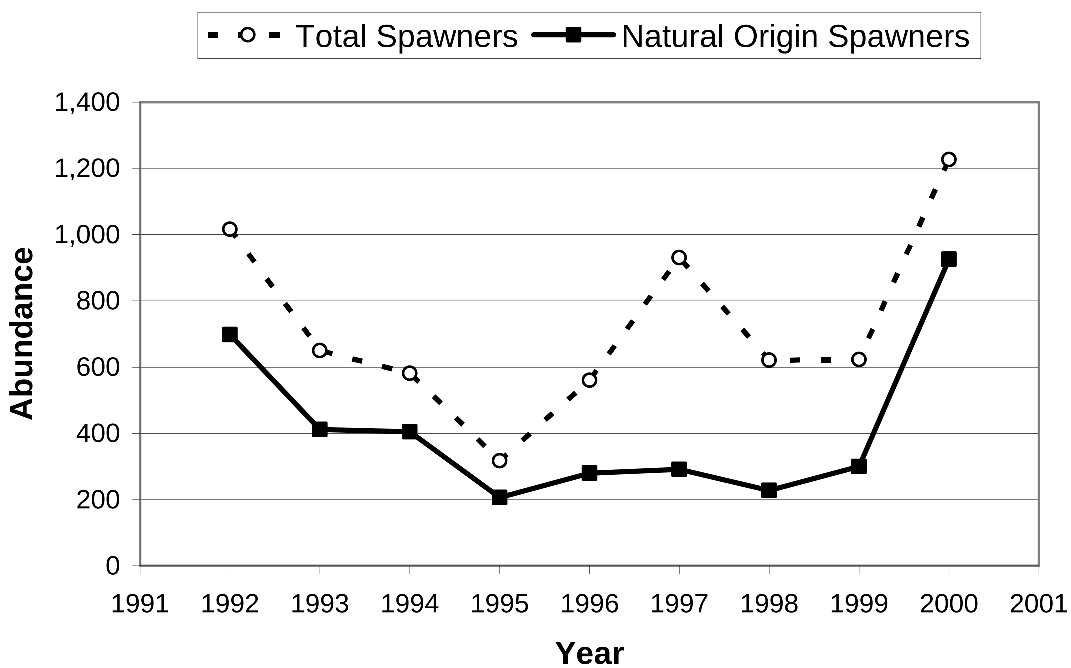


Figure B.2.4.16. Estimate of winter steelhead abundance in the Hood River.

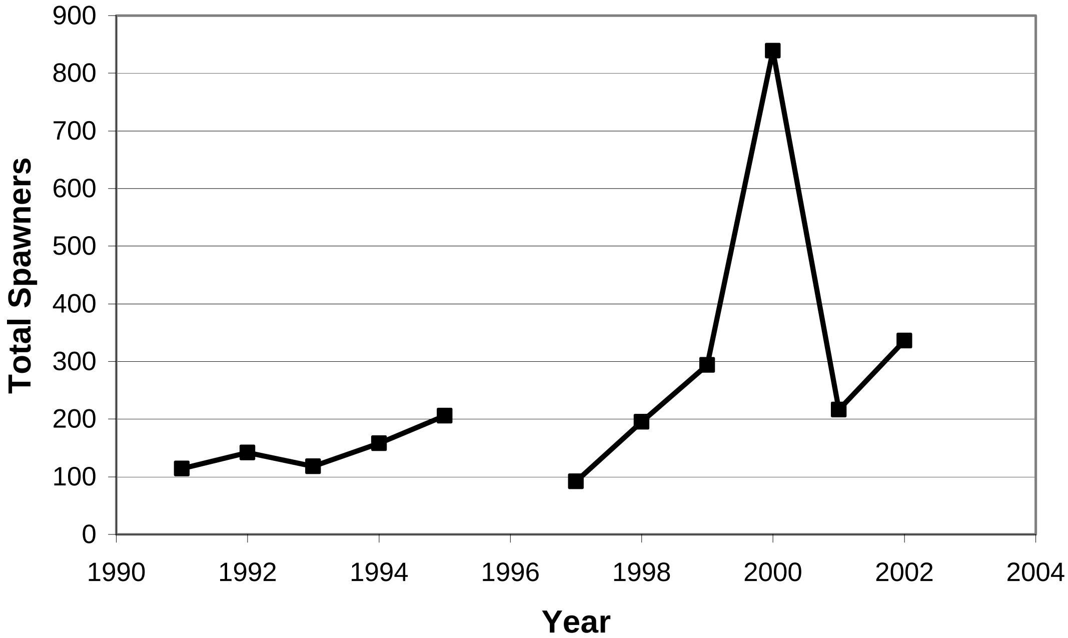
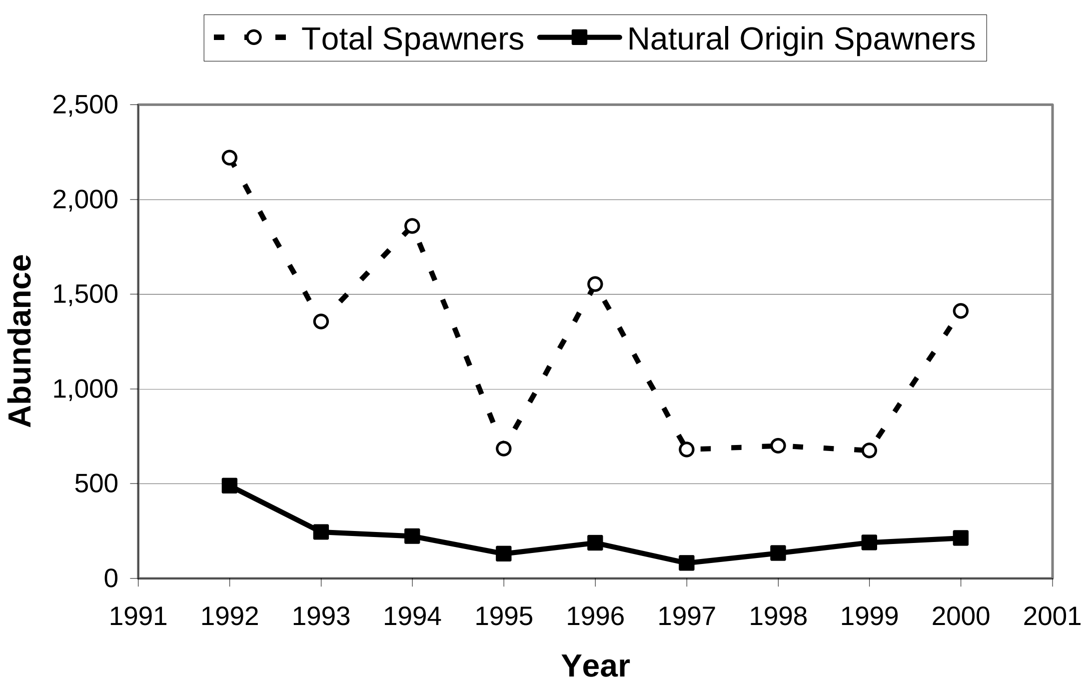
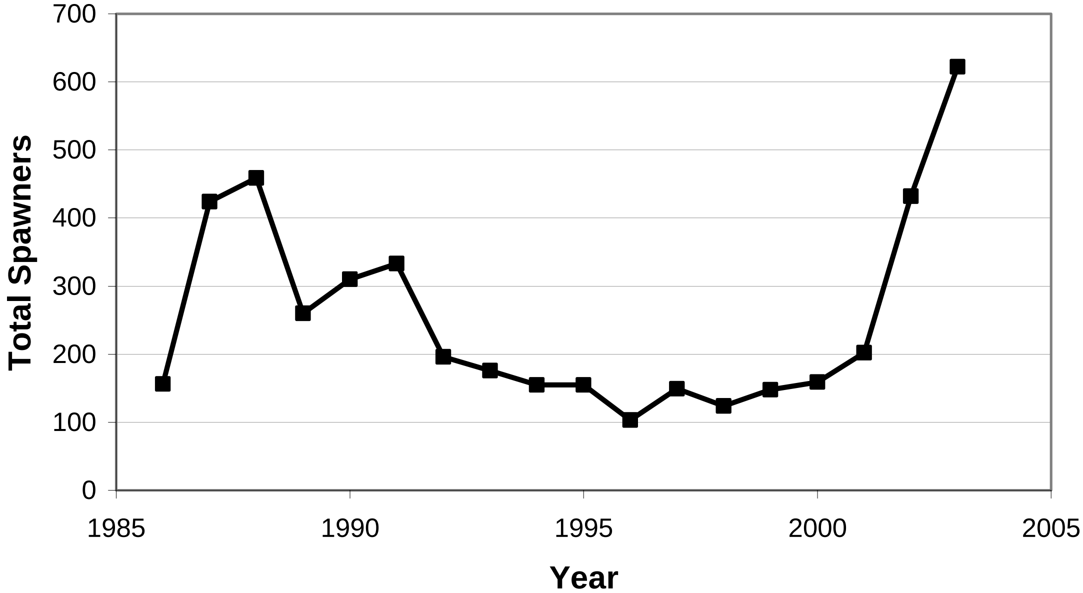


Figure B.2.4.17. Estimate of winter steelhead abundance in the Washougal River. The percent of hatchery-origin spawners is considered minimal.



B.2.4.18. Estimate of summer steelhead abundance in the Hood River.



B.2.4.19. Estimate of the total summer steelhead abundance in the Washougal River. The fraction of hatchery-origin fish is minimal (avg. approx. 3%)

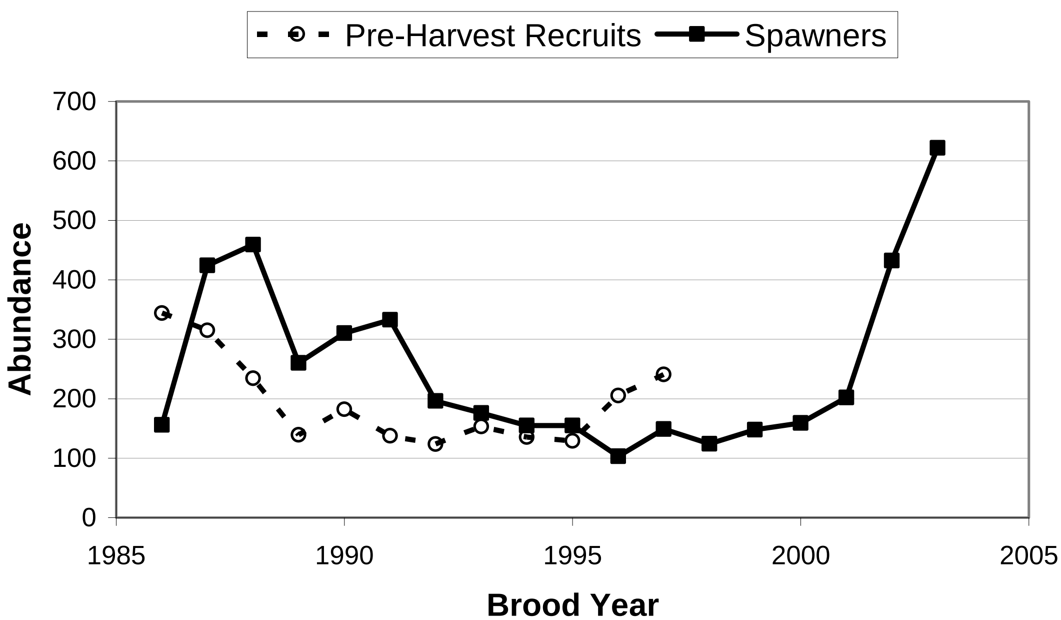
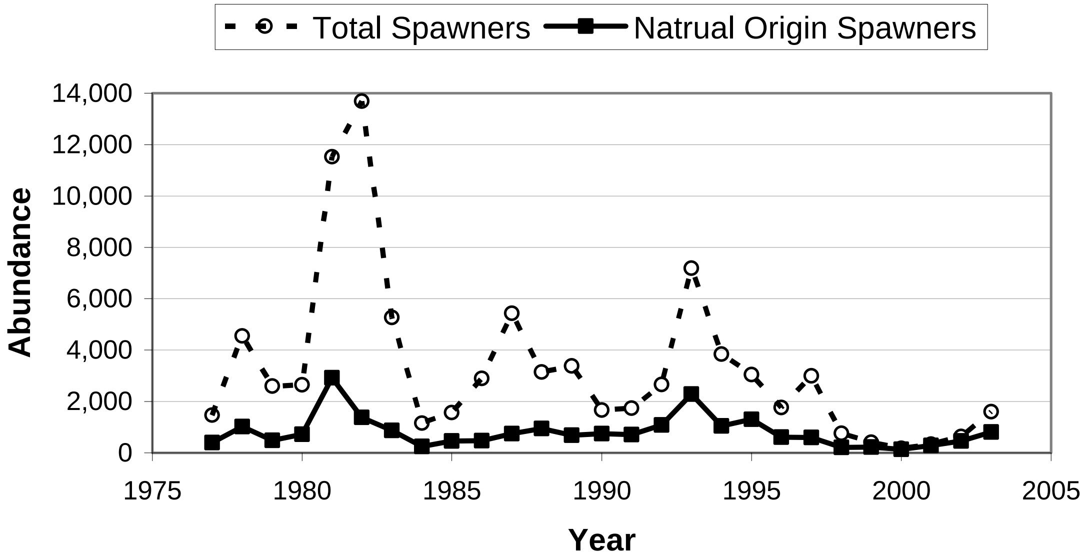


Figure B.2.4.20. Estimate of summer steelhead preharvest recruits and spawners in the Washougal River.



B.2.4.21. Estimate of summer steelhead abundance in the Kalama River.

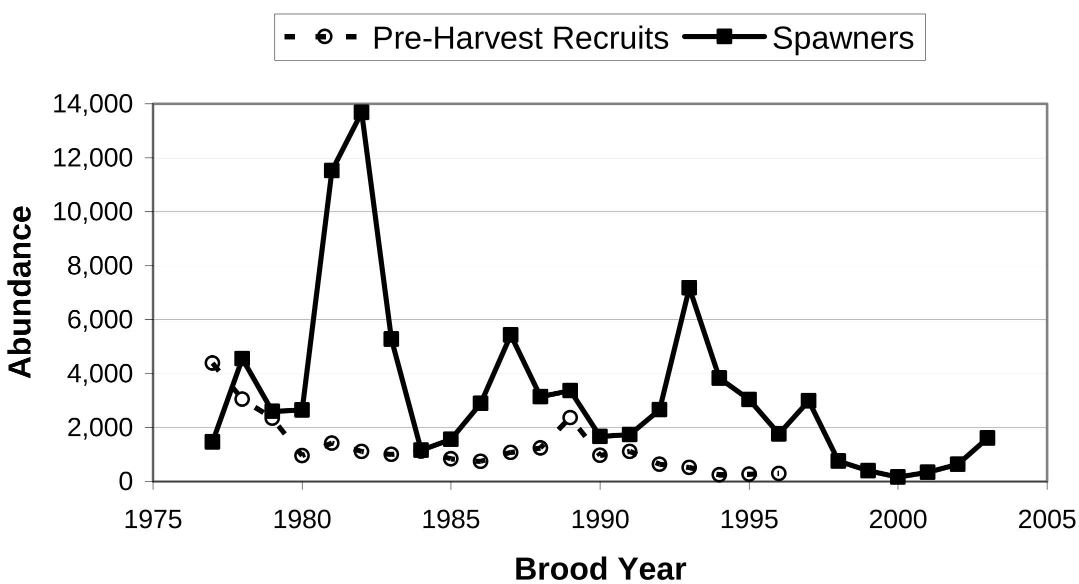


Figure B.2.4.22. Estimate of summer steelhead preharvest recruits and spawners in the Kalama River.

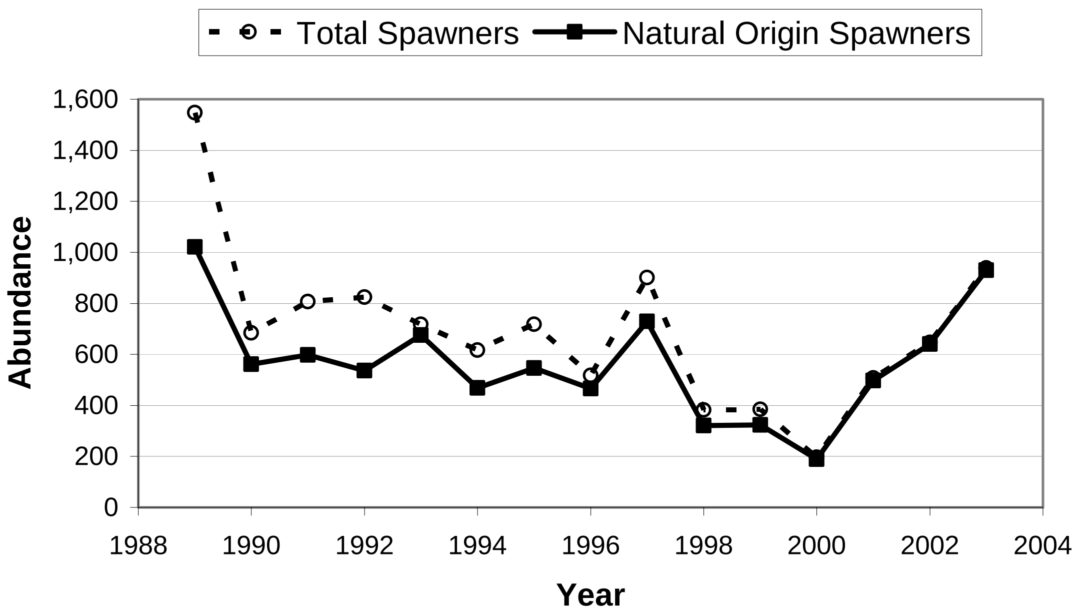


Figure B.2.4.23. Estimate of summer steelhead abundance in the Wind River.

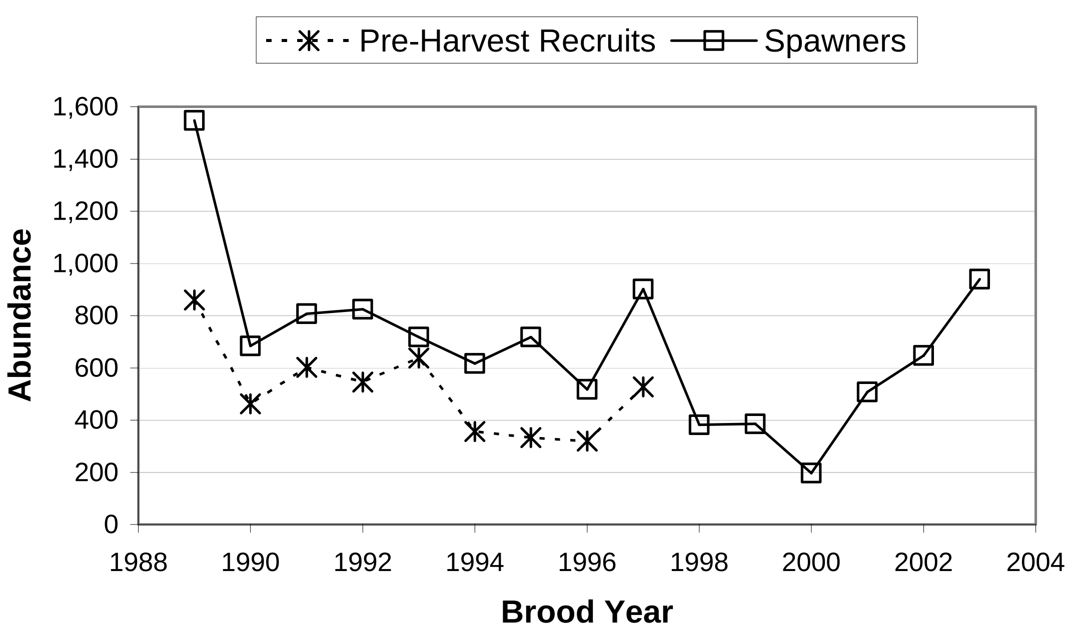


Figure B.2.4.24. Estimate of summer steelhead preharvest recruits and spawners in the Washougal River.

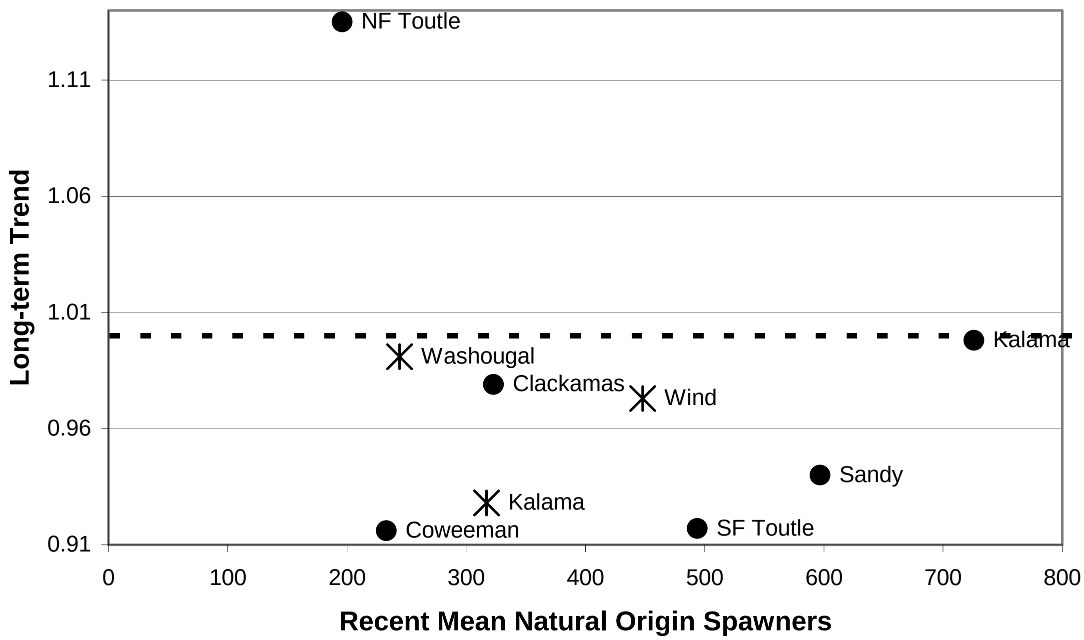


Figure B.2.4.25. Long-term trend vs. 5-year geometric mean abundance of natural-origin spawners. The "*" symbol indicates summer run populations. The dash line indicates a flat trend of 1.

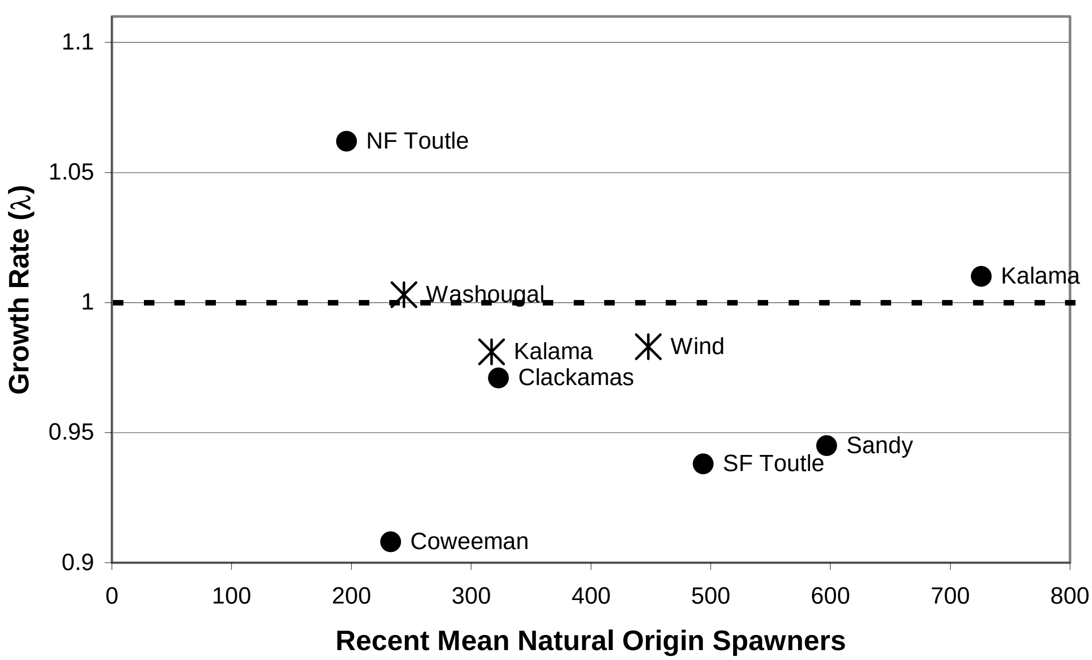


Figure B.2.4.26. Long-term growth rate vs. 5-year geometric mean abundance of natural-origin spawners. The growth rate is estimated assuming the reproductive success of hatchery-origin spawners is zero. The "*" symbol indicates summer run populations. The dash line indicates a flat trend of 1.

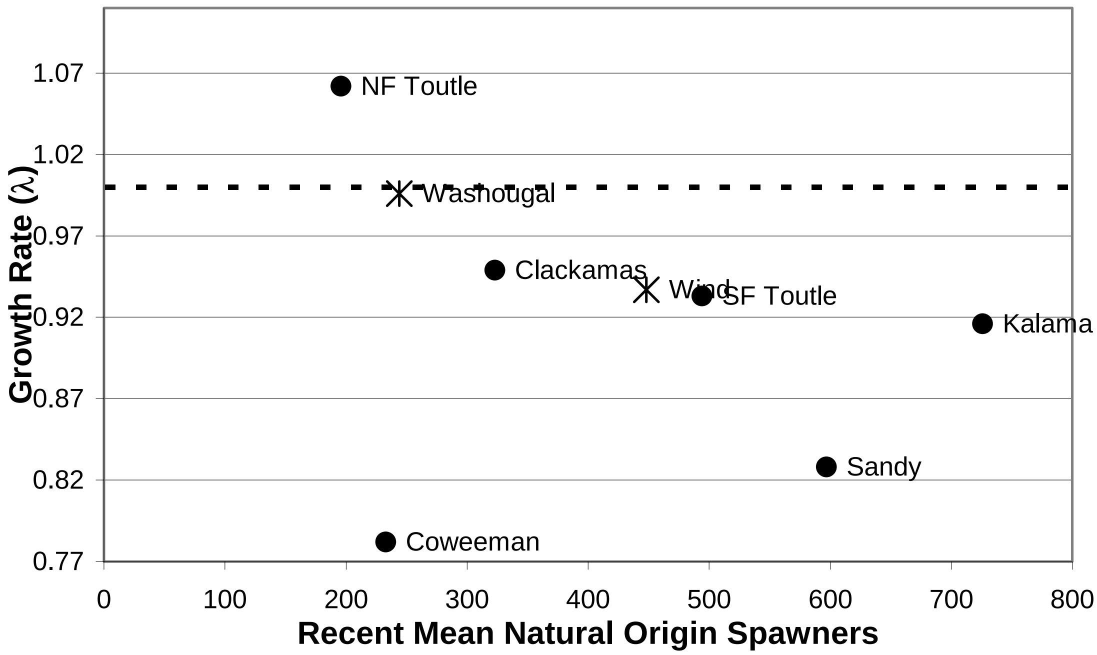


Figure B.2.4.27. Long-term growth rate vs. 5-year geometric mean abundance of natural-origin spawners. The growth rate is estimated assuming the reproductive success of hatchery-origin spawners is equivalent to that of natural-origin spawners. The "*" symbol indicates summer run populations. The dash line indicates a flat trend of 1.

B.2.5. UPPER WILLAMETTE RIVER STEELHEAD

B.2.5.1. Summary of Previous BRT Conclusions

The status of Upper Willamette River steelhead was initially reviewed by NMFS in 1996 (Busby et al. 1996) and the most recent review occur in 1999 (NMFS 1999). In the 1999 review, the BRT noted several concerns for this ESU, including the relatively low abundance and steep declines since 1988. The previous BRT was also concerned about the potential negative interaction between non-native summer steelhead and wild winter steelhead. The previous BRT considered the loss of access to historical spawning grounds because of dams a major risk factor. The 1999 BRT reached a unanimous decision that the Upper Willamette River steelhead ESU was at risk is of becoming endangered in the foreseeable future.

Current Listing Status: threatened

B.2.5.2 New Data and Updated Analyses

New data for Upper Willamette River steelhead include redd counts and dam/weir counts through 2000, 2001, or 2002 and estimates of hatchery fraction and harvest rates through 2000. New analyses for this update include the designation of demographically independent populations, and estimates of current and historically available kilometers of stream.

Results of new analyses

Historical population structure—As part of its effort to develop viability criteria for Upper Willamette River steelhead, the Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) has identified historically demographically independent populations (Myers et al. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany et al. 2000). Myers et al. hypothesized that the ESU historically consisted of at least four populations (Mollala, North Santiam, South Santiam and Calapooia) and possibly a fifth (Coast Range) (Figure B.2.5.1). There is some uncertainty about the historical existence of a population in the coast range. The populations identified in Myers et al. are used as the units for the new analyses in this report.

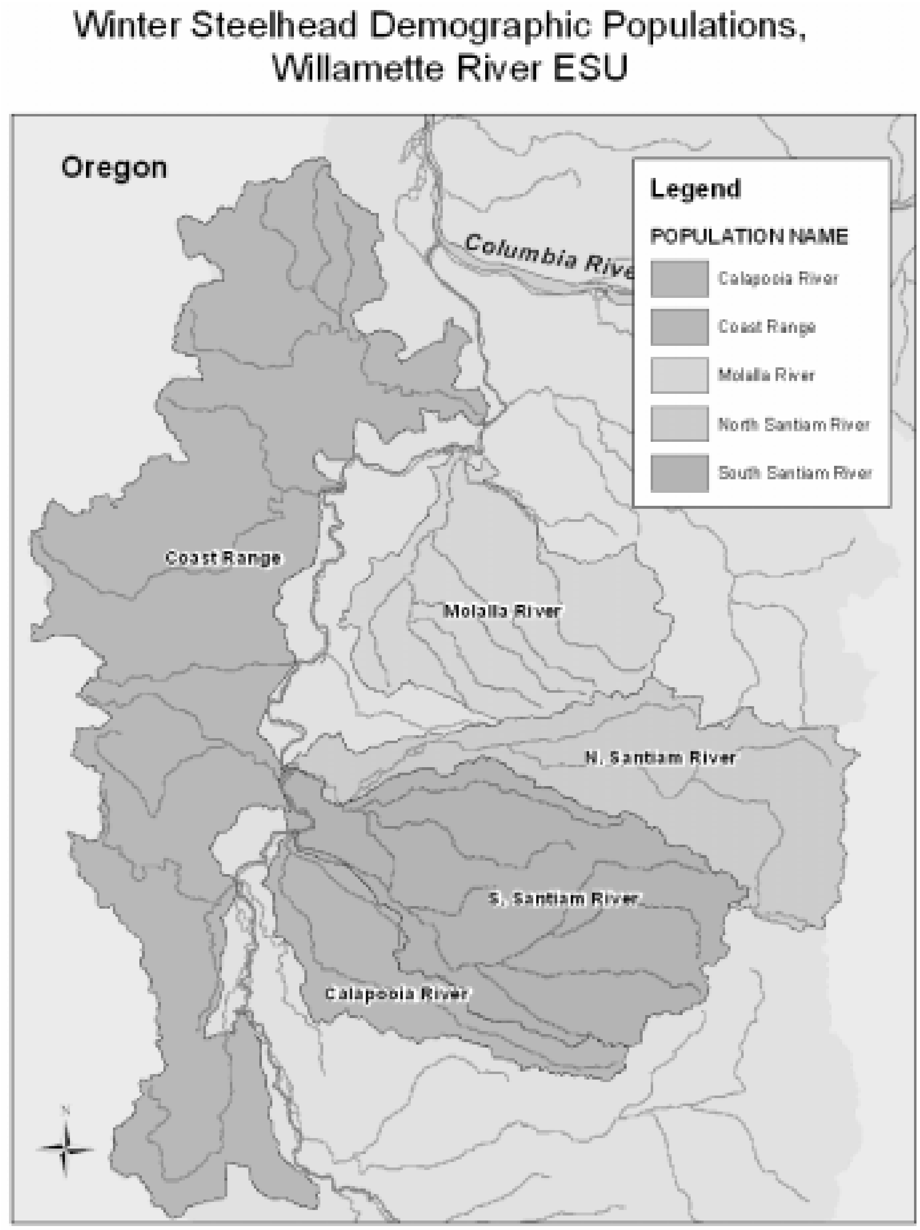


Figure B.2.5.1. Map of historical Upper Willamette River steelhead populations.

Abundance and trends

Willamette Falls - The number of winter steelhead passing over Willamette Falls from 1971 to 2002 is shown in Figure B.2.5.2. All steelhead in the ESU must pass Willamette Falls. Two groups of winter steelhead currently exist in the upper Willamette. The “late-run” winter steelhead exhibit the historical phenotype adapted to passing the seasonal barrier at Willamette Falls. The falls were laddered and hatchery “early-run” winter steelhead fish were released above the falls. The early-run fish were derived from Columbia Basin steelhead outside the Willamette and are considered non-native. The release of winter-run hatchery steelhead has recently been discontinued in the Willamette (Table B.2.5.1), but some early-run winter steelhead are still returning from the earlier hatchery releases and from any natural production of the early-run fish that has been established. One line on the graph of winter steelhead at Willamette Falls shows the combined early and late returns and the other line shows only the native late run. Non-native summer run hatchery steelhead are also released into the upper Willamette, but are not graphed. The geometric mean of late returning steelhead passing Willamette Falls over the years 1998-2002 is 5,819 steelhead and the arithmetic mean over the same period is 6,765 steelhead.

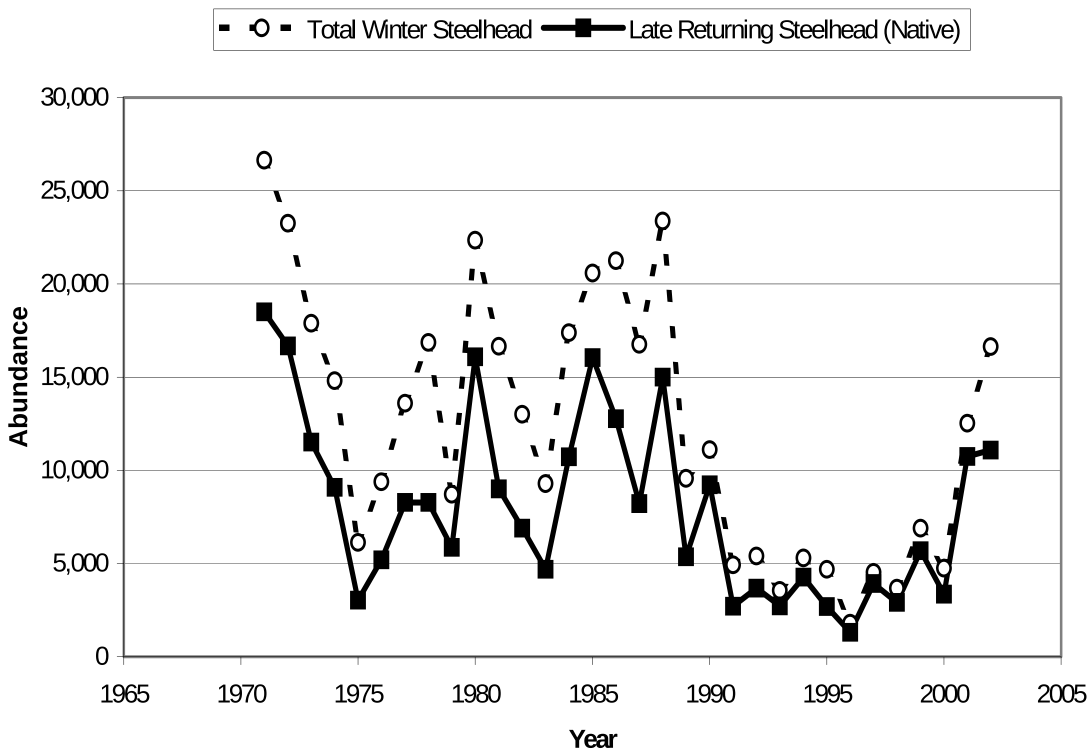


Figure B.2.5.2. Counts of winter steelhead at Willamette Falls.

Table B.2.5.1. The stocking of winter-run steelhead in the Willamette River has been discontinued. However, winter-run hatchery fish were still returning over the period of the available time series and summer run steelhead continue to be stocked in the Willamette. This table shows the last year of winter run releases in each of the basins.

Population	Last Year Winter Run Steelhead Released
Mollala River	1999
North Santiam River	1998
South Santiam River	1989
Calapooia River	No hatchery

The available time series data for individual Upper Willamette River steelhead populations consist of redd count index surveys, one dam count (Foster dam) and one hatchery trap count (Minto Trap). At one time, ODFW applied an algorithm involving the redd surveys and the length of available stream miles to apportion the fish passing Willamette Falls into individual populations. This approach appears to have been dropped in 1997 and there are currently no estimates of the absolute total numbers of spawners in the individual populations. The status of individual populations is discussed below.

Table B.2.5.2. Trends in redds per mile surveys of Upper Willamette River winter steelhead populations. The long-term trends use the entire data set and the short-term trends use data from 1990 through the most recent year. The 95% confidence intervals are in parentheses.

Population	Years of Data	Long-term Trend in Redds per Mile	Probability Long-term Trend < 1	Short-term Trend in Redds per Mile	Probability Short-term Trend < 1
Mollala	1980-2000	0.947 (0.918-0.977)	0.999	0.972 (0.867-1.090)	0.705
North Santiam	1980-2001	0.941 (0.906-0.977)	0.999	0.962 (0.845-1.095)	0.740
South Santiam	1980-2001	0.936 (0.904-0.970)	1.000	0.917 (0.811-1.037)	0.926
Calapooia	1980-2001	0.968 (0.933-1.003)	0.964	1.053 (0.935-1.149)	0.229

Molalla—A time series of redd-per-mile data from the Molalla shows a declining trend from 1980-2000 (Table B.2.5.2 and Figure B.2.5.3). Estimates of the fraction of hatchery-origin spawners for this population are shown in Figure B.2.5.9, and the estimated harvest rate in Figure B.2.5.10. The populations shows a declining trend over the available time series.

North Santiam—A time series of redd-per-mile data from the North Santiam show a declining trend from 1980-2001 (Figure B.2.5.4). A time series also exists the Minto trap on the North Santiam (Figure B.2.5.5). Minto is a hatchery acclimation-and-release site, so it is assumed that the majority of fish trapped at this site over the time series are of hatchery origin. Estimates of the fraction of hatchery-origin spawners for this population are shown in Figure B.2.5.9 and the estimated harvest rate in Figure B.2.5.10.

South Santiam—Counts of winter steelhead at Foster Dam (RKm 77) from 1967 to 2002 are shown in Figure B.2.5.6. A hatchery program was initiated in the 1980s and hatchery-origin fish were identified at the dam facility. Redd surveys are also conducted below Foster Dam (Figure B.2.5.7). Estimates of the fraction of hatchery-origin spawners for this population below Foster Dam are shown in Figure B.2.5.9, and the estimated harvest rate in Figure B.2.5.10.

Calapooia—A time series of redd-per-mile data from the Calapooia shows a declining trend from 1980-2001 (Figure B.2.5.8). Estimates of the fraction of hatchery-origin spawners for this population are shown in Figure B.2.5.9 and the estimated harvest rate in Figure B.2.5.10.

West Side Tributaries—No time series or current counts of spawner abundance for the west side tributaries population are available. It is questionable if there was ever a self-sustaining steelhead population in the west side. There is assumed to be little, if any, natural production of steelhead in these tributaries.

Loss of habitat from barriers

An analysis was conducted by Steel and Sheer (2003) to assess the number of stream km historically and currently available to salmon populations in the Upper Willamette River ESU (Table B.2.5.3). Stream km usable by salmon are determined based on simple gradient cut offs, and on the presence of impassable barriers. This approach will over estimate the number of usable stream km as it does not take into consideration habitat quality (other than gradient). However, the analysis does indicate that for some populations the number of stream habitat km currently accessible is greatly reduced from the historical condition.

Table B.2.5.3. Historical populations of Upper Willamette River spring chinook and loss of habitat from barriers. The potential current habitat is the kilometers of stream below all currently impassible barriers between a gradient of 0.5% and 4%. The potential historical habitat is the kilometers of stream below historically impassible barriers between a gradient and 0.5% and 6%. The current-to-historical habitat ratio is the percent of the historical habitat that is currently available.

Population	Potential Current Habitat (%)	Potential Historical Habitat (km)	Current to Historical Habitat Ratio
Mollala River	524	827	63
North Santiam River	210	347	61
South Santiam River	581	856	68
Calapooia River	203	318	64
West side Tributaries	1,376	2,053	67

Resident *O. mykiss* considerations

The available information on resident *O. mykiss* populations within the ESU is summarized in Table B.2.1.3 and Appendix B.5.1 and provides a broad overview of the distribution of Case 1, 2, and 3 resident populations within the ESU. See the section on Resident Fish in the Introduction section to the main body of this report for an explanation of the three cases and their relevance to ESU determinations. The section on Resident Fish in section B.1 of this steelhead report discusses how resident fish are considered in risk analyses.

Kostow (2003) has reviewed information on the abundance and distribution of resident *O. mykiss* for this ESU and found no quantitative estimates of abundance for resident *O. mykiss* in any UW population. However, expert opinion indicates that resident *O. mykiss* are rare in this ESU. Cutthroat trout (*Oncorhynchus clarki)* are found through much of the Willamette River Basin and tend not to co-occur with resident *O. mykiss*. Resident *O. mykiss* in the Middle Fork Willamette and McKenzie River might normally be considered to be Case 1 because there are no obvious barriers to anadromous access to these areas. Nevertheless, there is no evidence that steelhead historically inhabited these basins, and the resident fish in these basins are morphologically distinctive (being known locally as “McKenzie redsides; Kostow 2003). These upper basin resident fish are also genetically quite different from Upper Willamette ESU steelhead (NMFS unpublished data), and they are not considered part of the Upper Willamette River ESU (cite FR notice; status review or update memo)

Resident or residualized rainbow trout are found above the dams on the North and South Santiam Rivers; historically, these areas were the primary production areas for steelhead in this ESU. We are not aware of specific information relevant to the ESU status of these Case 3 resident populations. Resident *O. mykiss* are found in the numerous small waterfalls that exist in the headwater regions of this ESU.

B.2.5.3. ESU Summary

Based on the updated information provided in this report, the information contained in previous Upper Willamette River steelhead ESU status reviews, and preliminary analyses by the WLC-TRT, we could not conclusively identify a single population that is naturally self-sustaining. All populations are relatively small, with the recent mean abundance of the entire ESU at less than 6,000. Over the period of the available time series, most of the populations are in decline. The recent elimination of the winter-run hatchery production will allow estimation of the naturally productivity of the populations in the future, but the available time series are confounded by the presence of hatchery-origin spawners. On a positive note, the counts all indicate an increase in abundance in 2001, likely at least partly as a result of improved marine conditions. The issue of changing marine conditions is discussed in the introduction to this update report, as it is an issue for may ESUs.

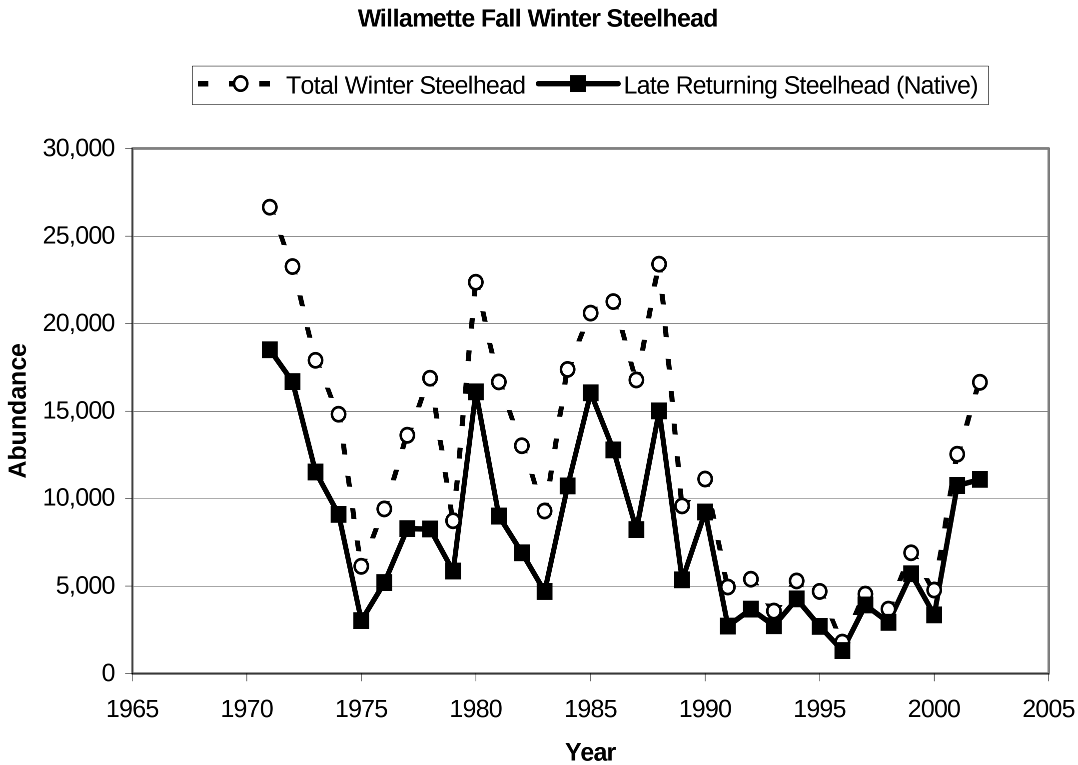


Figure B.2.5.2. Counts of winter steelhead at Willamette Falls.

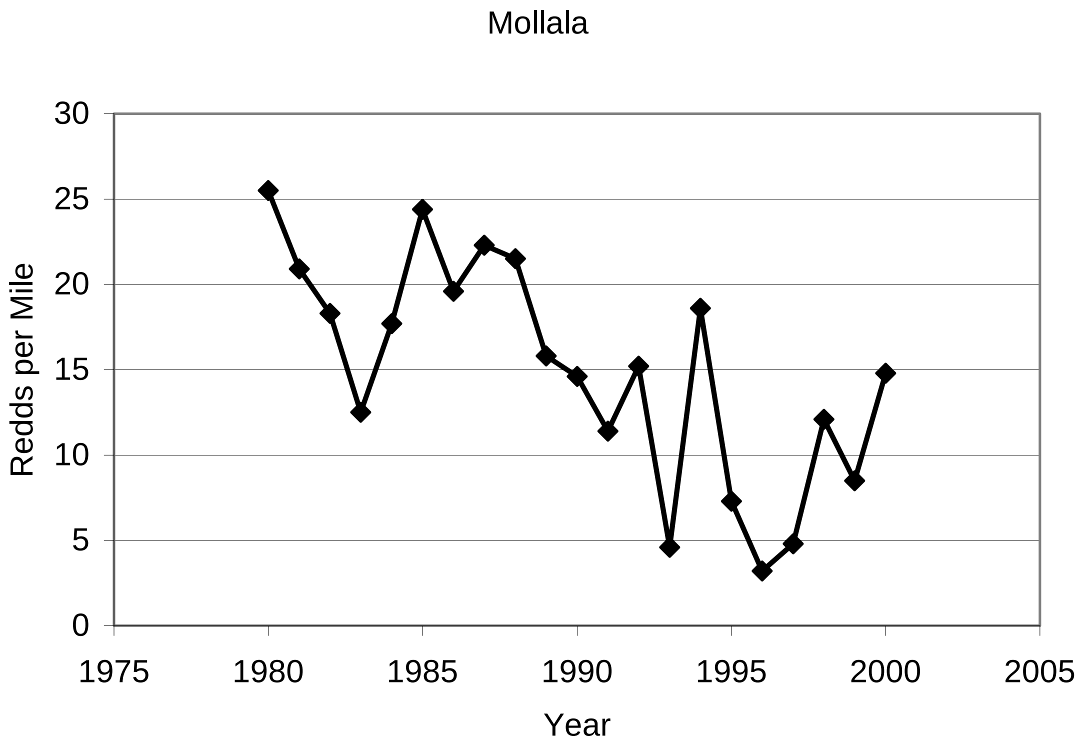


Figure B.2.5.3. Redd surveys of winter steelhead in the Molalla.

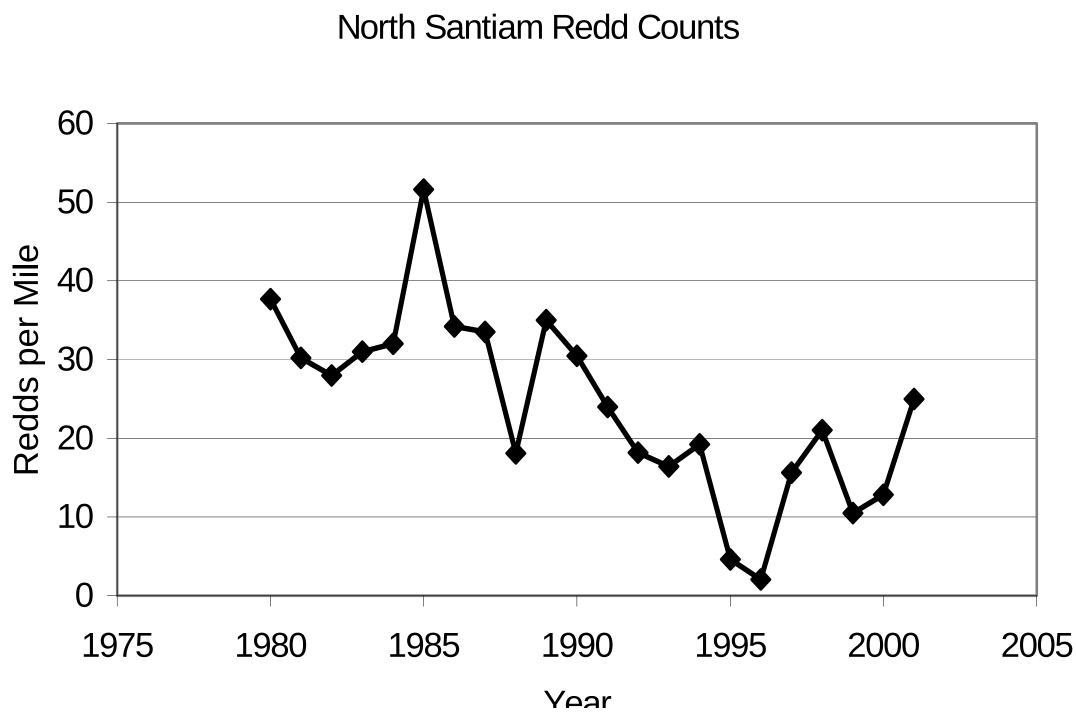


Figure B.2.5.4. Redd surveys of winter steelhead in the North Santiam.

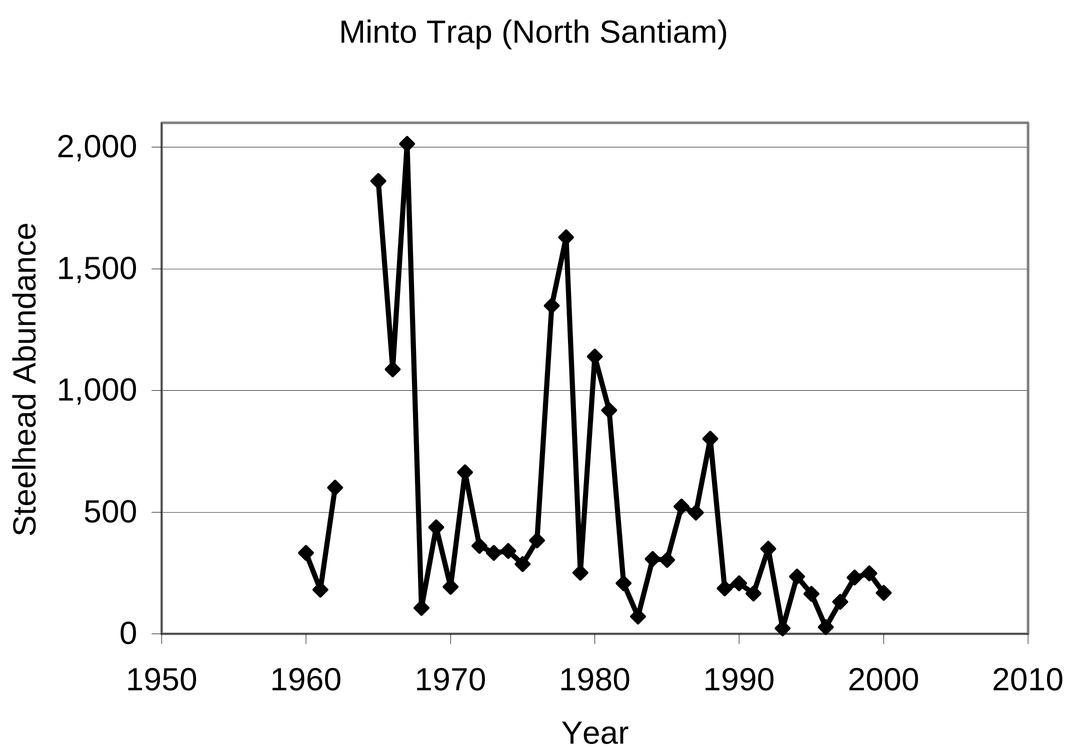
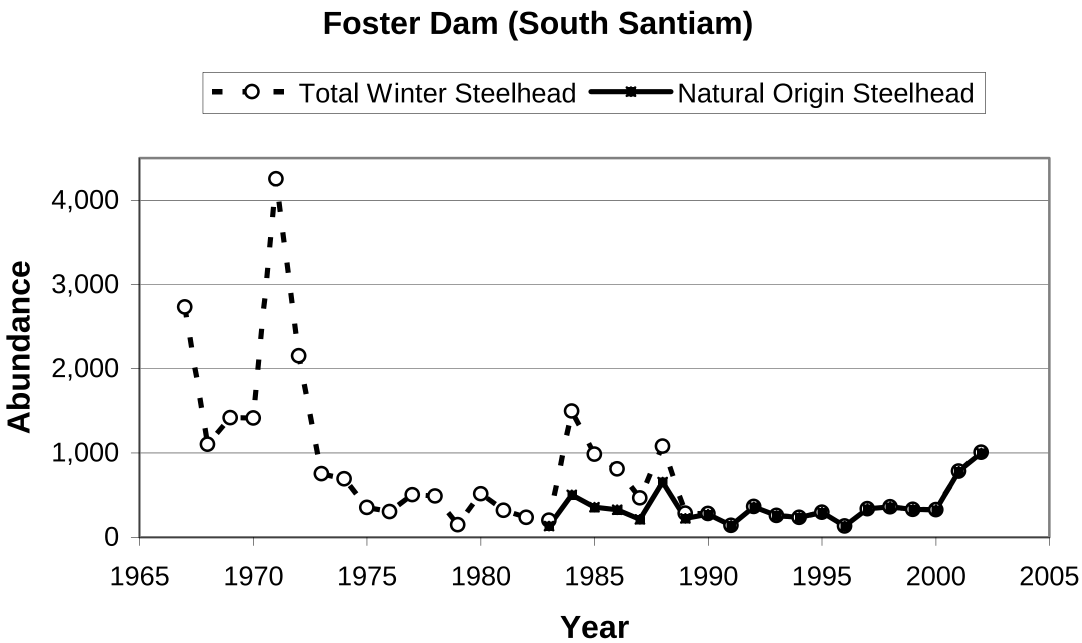


Figure B.2.5.5. Counts of winter steelhead at the Minto trap on the North Santiam. Minto is a hatchery-acclimation pond and release site.



B.2.5.6. Counts of winter steelhead at Foster Dam on the South Santiam (RKm 77).

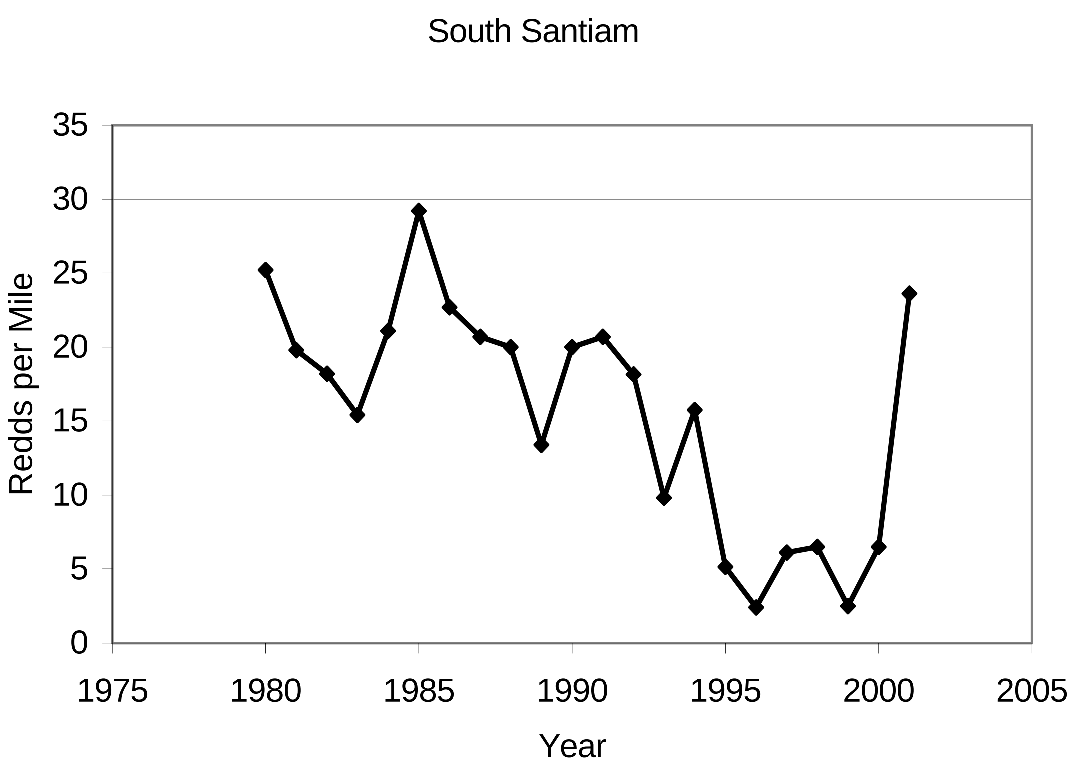


Figure B.2.5.7. Redd surveys of winter steelhead in the South Santiam below Foster Dam.

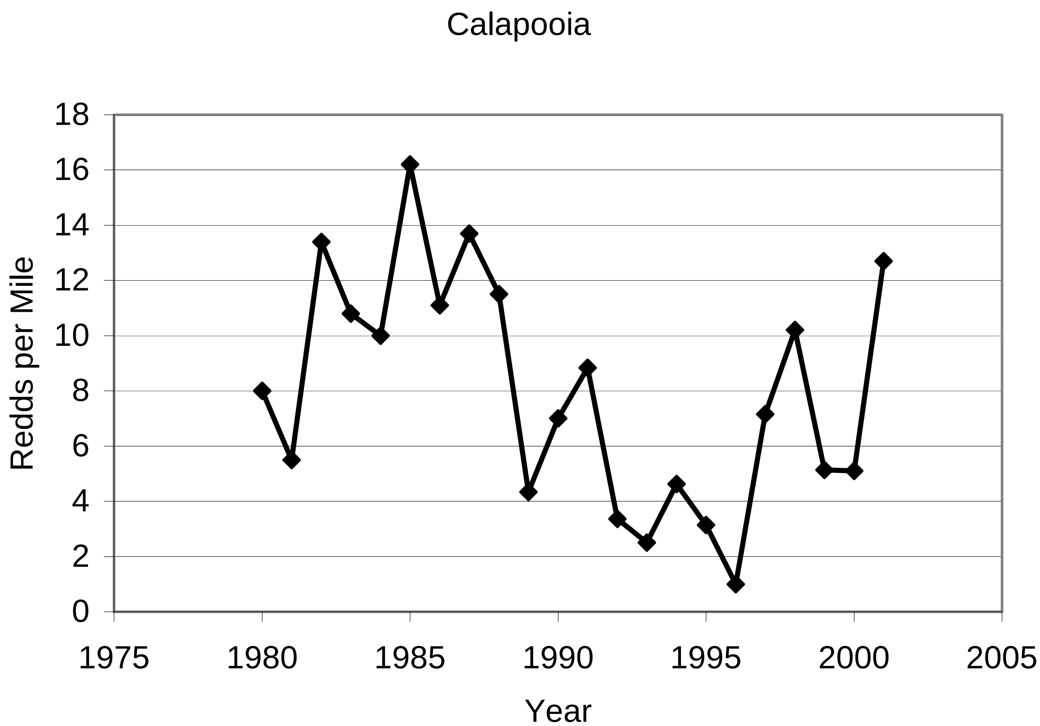


Figure B.2.5.8. Redd surveys of winter steelhead in the Calapooia River.

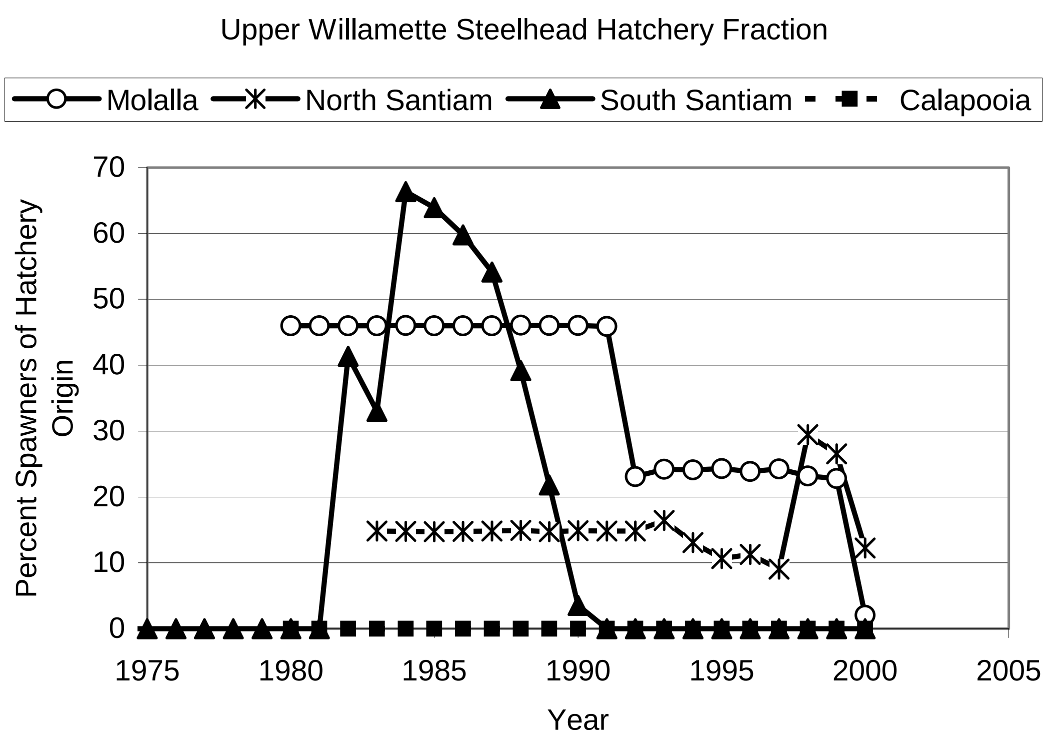


Figure B.2.5.9. Estimates of the fraction of hatchery-origin spawners in populations of UW winter steelhead (Chilcote 2001). Winter steelhead are not currently released into the UW.

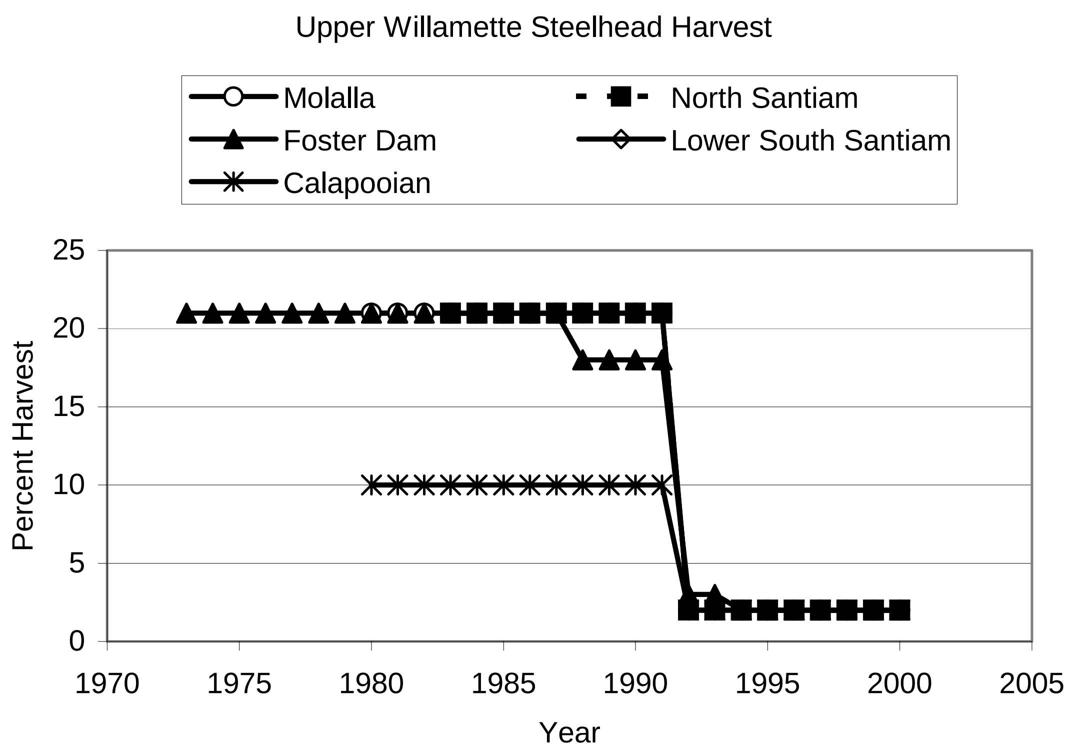


Figure B.2.10. Estimates of the harvest rate on populations of UW winter steelhead (Chilcote 2001).